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FOR ENGINEERS AND CONTRACTORS CONTROLLING THE DESIGN, SPECIFICATION, INSTALLATION AND MAINTENANCE OF HEATING, VENTILATING AND AIR CONDITIONING.

HEATING & VENTILATING
AIR CONDITIONING

FOR AUGUST, 1939

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STORAGE REFRIGERATION

With increasing attention being paid to possibilities of storage in order to keep down operating costs, information on application has been lacking. For some suggestions and some data, see page 13.

INDUSTRIAL EXHAUST DESIGN

An engineer, employed by manufacturer whose dust problem is acute and important, suggests how suitable branch pressures may be fixed and how workable piping for exhaust systems can be secured. See page 16.

NEW YORK WORLD'S FAIR

There is a great deal of interest concerning heating and ventilating at the Fair but it is so widely scattered that it is hard to find unless you know where it is located. Photographs on pages 19 to 25 illustrates principal locations and show many of the interesting features.

WINDOWLESS FACTORY

The windowless factory building of Simonds Saw and Steel Company has been attracting public attention for a good many years. It has just been completed and is now in operation. See page 26.

ASHVE SUMMER MEETING

Resume of principal papers on pages 31 to 33.

REFRIGERATION SAFETY CODE

New code just adopted as American Standard contains many provisions not found in the earlier code on the subject. Points bearing especially on the subject of air conditioning are included in the article beginning on page 39.

Photograph used on this month's cover is by courtesy of The Austin Company.

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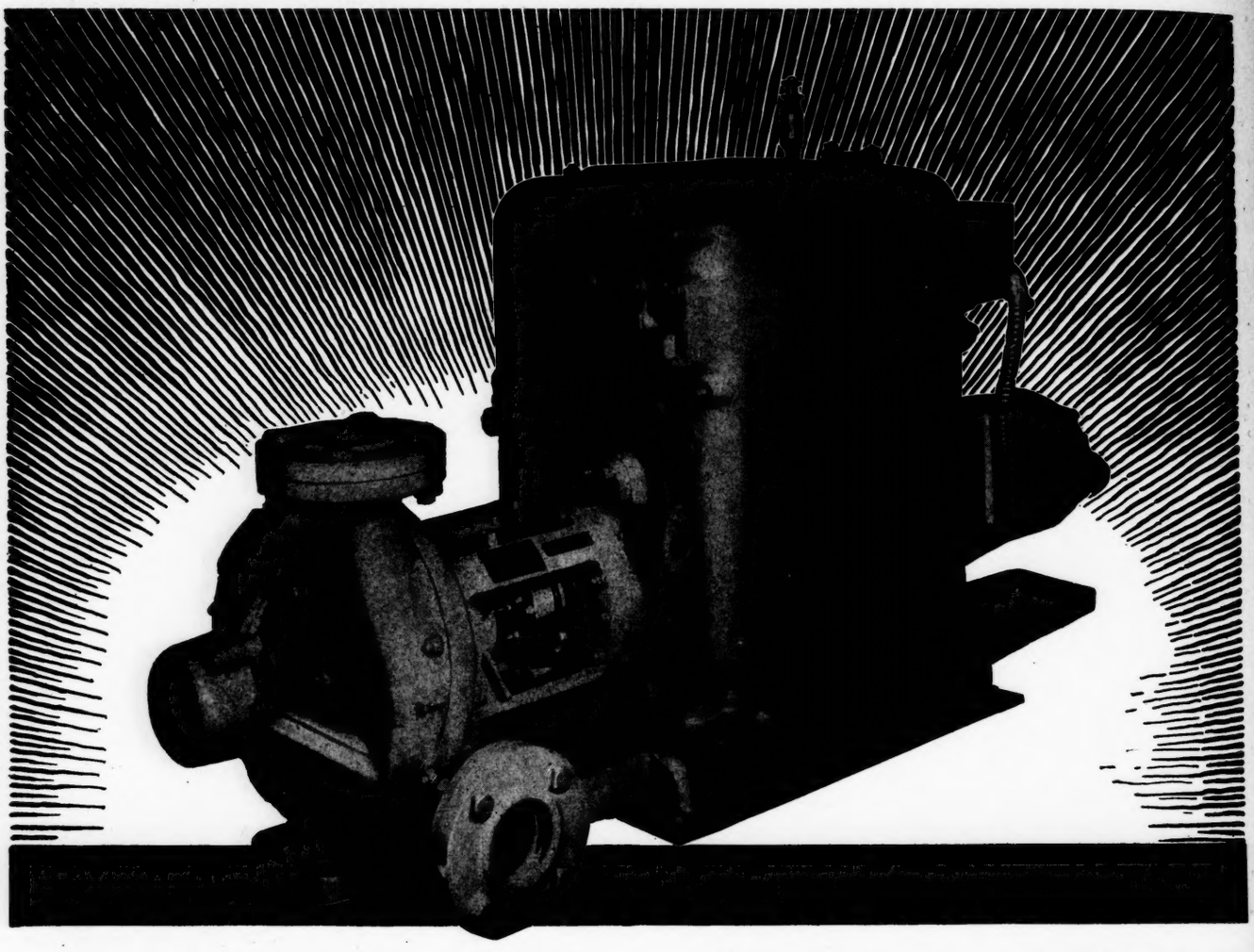
Safety!

THE NASH VAPOR TURBINE HEATING PUMP IS NOT STOPPED BY ELECTRIC CURRENT FAILURE



For service in greenhouses, hospitals, schools, theatres, and public buildings, where heat failure is a serious matter, the Nash Vapor Turbine Return Line Vacuum Heating pump should be specified, for this pump operates perfectly without electric current.

This is because the motive power is a special turbine operating on steam direct from the heating system. Steam used to drive the Vapor Turbine is returned to the system for heating, with little heat loss.

This pump insures constant heat in the system, it eliminates electric current cost, and it promotes high efficiency in the heating system. Heating efficiency is due to the fact that this pump can operate continuously with economy. Continuous operation means uniform circulation, and uniform conditions in the system mean steam saving.

This pump has but one moving part, no internal wearing parts, and requires no internal lubrication. Bulletin D-246 tells all about it, and it is free on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

Data on the Design of Ice Storage Air Conditioning Systems

The Salvation Army headquarters building, Detroit, Michigan. This building has a 75-ton air conditioning load which is carried with a 20-ton ice storage system. The architect is A. C. Fehlow while the author designed the air conditioning.

By CARL F. BOESTER†

Ice storage air conditioning systems when properly designed will frequently show considerable savings over conventional equipment particularly in applications having a low load factor. However, some engineers have failed to secure such savings because they were not familiar with all of the application principles involved. In this article the author discusses the principles of ice storage systems and points out some of the more important points which must be kept in mind in designing such systems. He is especially well qualified to discuss this subject as he has installed a large number of ice storage systems throughout the country.

THE principle of storage refrigeration and the methods of accomplishing it are by no means new or novel. It has been used for many years in various applications and with various degrees of success. Refrigeration can be stored in the form of chilled water in a large tank, in the form of chilled brine in a somewhat smaller tank or in the form of ice in a still smaller tank.

As applied to air conditioning storage, refrigeration offers in many applications certain advantages which are not obtainable with conventional equipment. However, the application of storage refrigeration to air conditioning cannot alone contribute to lower first costs but it permits certain practices which are conducive to a lower over-all first cost. Many application engineers have failed to find a saving in favor of storage refrigeration simply becouse they were not familiar with all of the application practices involved. For example, the saving in cost between a 25 and a 50 hp. compressor often will not pay for the additional cost of the storage equipment and the conclusion might be that no savings are possible. However, before discussing possible savings on typical applications, it would be well to discuss the methods of storing refrigeration and then decide upon what might be a practical and economical method of working out such an application — that is, to set forth what constitutes an efficient low cost storage system.

As mentioned before, refrigeration can be stored in the form of chilled water, chilled brine or ice. In the writer's opinion the storing of chilled water is not desirable in that it requires a tank having a capacity of some 200 cu. ft. for every 288,000 B.t.u. of refrigerating effect stored. Rarely, if ever, is space available to permit such storage, and the large tank required usually costs much more than the economics of the project permit. Furthermore, it is difficult to control the temperature of the water being withdrawn from the tank

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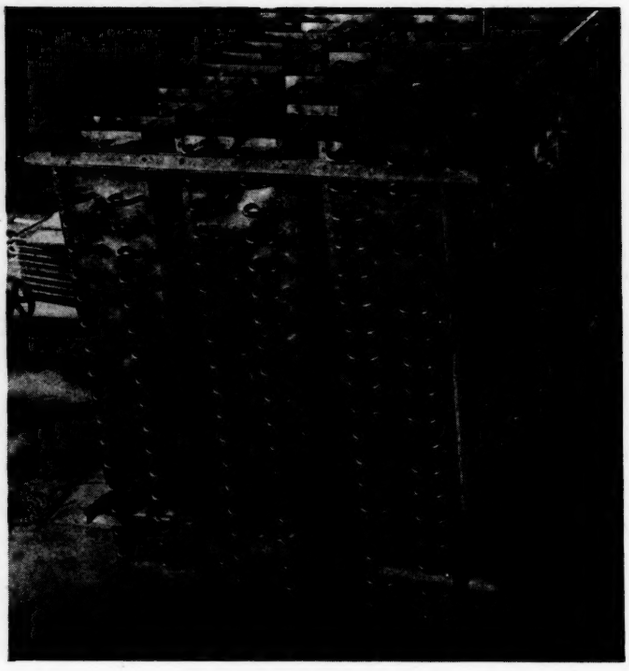

A 3-ton ice accumulating evaporator before being installed in tank. This evaporator builds up ice during periods when refrigeration is not needed.

and because of the exceptional size of the tank, tank losses are considerable.

The second method—that of storing up brine—while requiring a tank much smaller in cubic capacity per ton of refrigeration accumulated, has the disadvantage of requiring the evaporator equipment to work at very low temperatures, which materially penalizes the high side equipment. Brine, as a rule, is quite corrosive and because it is low in temperature when leaving the storage unit, it is quite difficult to control the temperature of the cooling coils in the air stream, which means that the air is often over-dehumidified and sometimes the coils frost up. Because of the low temperature of the brine in the storage unit, which is usually plus 10F, the tank losses are high unless heavy and expensive insulation is used.

This brings us to the third method—that of accumulating and storing up ice. This can be accomplished by a can ice plant or by use of equipment similar to the flake ice machine, the only disadvantage being that such equipment is high in first cost. A simpler method is to have a tank of water in which evaporator coils are submerged, on which coils the ice is frozen, and thus accumulate ice for storage purposes.

There have been many applications of this simple principle—of various kinds and capacities. A ton of ice displaces approximately 37 cu. ft. of space. Since space is a prime factor in evaporator design or arrangement, the ideal design is one that will permit the accumulation of ice in space limitations approaching those of the displacement of ice. Evaporator surface requirements, from long experience, seem to be approximately 80 sq. ft. of surface per ton of ice accumulated for efficient operation. Many engineers have been using this amount of surface but have been building their evaporators of 1¼-in. pipe, having enough lineal feet to provide the 80 sq. ft. of surface necessary.

Now an evaporator constructed of tubing of this size has many disadvantages, the primary one being physical dimensions. In order that 80 sq. ft. of surface be provided in an evaporator to accumulate 1 ton of ice, a tank will be required having dimensions of 30 in. in width, some 65 in. in height and 10 ft. in length. This is better than three times the displacement of a ton of ice. If less surface were used in order to get the evaporator into a smaller space, the thickness of ice accumulated on the 1¼-in. pipe evaporator would be materially increased and the suction pressure would go way down.

Another difficulty with an evaporator of this type is that after the ice is accumulated on the evaporator and is partially used off of it, there is a large quantity of water surrounding the evaporator in proportion to the quantity of ice left. Therefore, it is practically impossible to withdraw low temperature water from the storage tank even though there may be some ice still on the evaporator coil. Other difficulties in using this type of evaporator are the method of feeding the refrigerant, the excessive refrigerant charge and the uneven accumulation of the ice on the evaporator coil because of the inability to control the refrigerant feed and flow. Iron pipe evaporators also have a considerable pressure drop that is conducive to low back pressures, and their tendency to rust makes their lifetime short. Their only advantage seems to be that for a given amount of surface—namely 80 sq. ft.—the cost is somewhat less than that of other types of evaporators.

The writer has developed an evaporator constructed of ⅝-in. copper tubing. An evaporator capable of accumulating 1 ton of ice contains some 500 lineal feet of ⅝-in. copper tubing placed on 3½-in. centers so that the over-all dimension of the block of ice at the completion of the accumulating cycle is approximately 14 in. x 63 in. x 84 in., displacing approximately 43 cu. ft. of space. This displacement includes both ice and evaporator. This is an extremely compact arrangement and is conducive to low cost.

Of great importance is the fact that in the tank in which the evaporator section is submerged, there is not a disproportionate quantity of water for the volume of ice in the tank. Therefore it is possible during the entire operating period in which refrigeration is required for air conditioning purposes to have a definite quantity of water at a constant temperature. This being possible, considerable saving is effected in pumping equipment because a small volume of low temperature water can be handled and a smaller coil used in the air stream since less surface is required due to the lower refrigerant temperature.

An evaporator section of this sort, constructed of small, light tubing, has been found to be quite practical. There is no weight whatsoever on the evaporator sections because ice is lighter than water and there is a tendency for the section, with its accumulation of ice, to float. The light construction of the evaporator permits the necessary expansion or contraction without harm to the evaporator.

The method of feed of refrigerant and refrigerant charge is of great importance. An evaporator of this design requires the minimum of refrigerant charge and if fed properly, the ice is accumulated evenly on the

tubes of the evaporator section because the boiling of the refrigerant takes place progressively in the tubes of the evaporator as the ice is accumulated. This makes possible a high superheating of the refrigerant gas and therefore it is possible to operate the compressor at average suction temperatures for Freon—27 to 28F—considerably higher than any other method with which the writer is familiar.

The flow of the refrigerant through the evaporator section is controlled by a multiport thermal expansion valve, the superheat adjustment of which is usually not more than 3 or 4F. The coil is thus operated dry and requires a minimum of refrigerant. An average charge for a 1-ton Freon ice accumulating coil is 25 lb. This is for the evaporator alone and does not include any piping, condenser or receiver capacities.

While anyone with a reasonable amount of practical experience with refrigerating equipment can construct an ice storage system and freeze ice on evaporator coils submerged in water, the value of experience with storage applications is shown when it comes to determining the best way to melt the ice off of the evaporator coils once the ice is accumulated.

By way of illustration, if the water volume circulated to the conditioning equipment is small and the temperature rise through the conditioning equipment slight, it is quite difficult to melt the ice at the desired rate to produce the cooling effect desired. There is a definite minimum water volume that can be circulated per ton of capacity and there is a definite minimum temperature rise of the water through the conditioning equipment. For the water volume and the temperature rise there must be a given number of square feet of ice surface exposed at all times to the flow of the water through the storage tank in order that the ice be melted at the proper rate. Sometimes it is necessary to use an auxiliary pump to agitate and stir up the water in the tank in order to get a proper melting rate. Another way to accomplish this is to break the evaporator coil up into a sufficient number of sections in order that adequate surface be exposed to the flow of water for a given water volume and a given temperature drop through the storage unit.

While no practical equation has been as yet worked out for determining what the heat transfer factor might be under given sets of conditions because of the many variables involved, the writer is working on a method which should make it possible to determine this value. Meanwhile the writer has considerable data applicable to various combinations of conditions calculated from actual applications, and will be glad to pass on such information to those interested if a given set of conditions is submitted.

Ice storage tank with evaporator installed ready for use. Water circulating pipes can be seen at top of tank. These pipes during off periods circulate water to be frozen and during periods when refrigeration is needed circulate the water to be cooled.

Too much importance cannot be placed upon the ability to melt the ice at the required rate.

If the interest shown in storage refrigeration this year as compared with previous years is any criterion of the acceptance of this principle by air conditioning application engineers, then it should not be long before this method is generally adopted. Electric utilities are well aware of the fact that this method makes possible the leveling out of a very undesirable peak and are aggressively pushing the general acceptance of the principle of storage refrigeration as applied to air conditioning and establishing special rates for the benefit of those who employ this type of system.

Air Conditioning A Wine Cellar

CONDITIONS approximating those in the famous wine storage cellars of France are maintained in the French Pavilion at the New York World's Fair for the storage of rare wines served in the restaurant.

Temperature is kept at a constant 60F at all times by mechanical refrigeration and cold diffusers installed by Carrier Corporation, which also air conditioned other parts of the Pavilion with a 162-ton system.

The artificial *wine cellars* which are located on an upper floor, were decided upon after experts ruled that fine French wines would lose body and bouquet if left in varying temperatures. After experimentations by engineers, cold diffusers and refrigeration were found to furnish conditions closely approximating those at Rheims and other wine centers.

Through the re-use of condenser water, engineers have cut cooling costs at the French Pavilion. The condenser water from the refrigerating units which cool the auditorium and south restaurant is sprayed on the roofs of these areas to remove part of the heat load from these sources. This causes a considerable reduction in the amount of refrigeration needed.

ARE YOU BUYING AN EXHAUST SYSTEM?

Part 1—Fixing Suitable Branch Pressures and Obtaining Workable Piping

By F. F. KRAVATH†

This article is the first of a series of three in which the author outlines methods which he feels will clarify some of the problems faced when the purchase of an industrial exhaust system is being considered. Installments of this series will appear in early issues.

FOR many years, there have been in existence, in various states, regulations or codes governing atmospheric pollution in industrial establishments. Even before the terms *silicosis* and *pneumoconiosis* were invented, it was recognized that working in a poorly ventilated shop where the air might be dust or fume laden, regardless of the particular dust or fume, was definitely detrimental to good health. Hence progressive state administrations began to instruct their factory inspection personnel to insist on the elimination of these obvious hazards. Since, in most cases the obvious way to eliminate the hazard was thru an exhaust system, and since some enforcement or inspection bureaus felt that you couldn't tell a shop to install an exhaust system unless you, at the same time, gave it some minimum standards to adhere to, the standards formed the foundation upon which are built the more or less elaborate engineering codes of today, codes which are given very sharp teeth by the enactment of subsequent legislation relevant to occupational disease and workmen's compensation.

State Codes

Since, in every case, some form of hood or orifice would exist at each inlet to the exhaust system, the first codes specified that a certain suction or static pressure (usually -2 inches water gauge) must exist in the branch pipe a definite distance back from the hood (usually 15 to 18-in.) This distance was made great enough to clear the turbulent flow conditions prevalent in the branch pipe close to the hood and yet was made short enough so that the static pressure would contain only a negligible element of pipe resistance pressure. As can be seen from Fig. 1, there is a constriction in the actual air column shortly beyond the point where air enters the branch pipe. This vena contracta effect varies with each individual hood. The ratio of the area of the air column at the vena contracta to the area of the branch pipe is referred to as the coefficient of restriction, and for average hoods is taken as 0.71.

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If we refer to the equation

$$v = 4006\, f \sqrt{SP} \qquad (1)$$

where v = branch pipe velocity
f = coefficient of restriction
and SP = static pressure
letting $f = 0.71$ and S.P. = 2.0,
v = approximately 4000 ft. per min.

A branch velocity of 4000 ft. per min. has been very commonly used in exhaust work and for most fine material is more than ample. Hence we see the derivation of the 2-in. standard.

Unaware of the laws of air flow, certain legislators in their zeal to exceed the requirements of neighboring states indiscriminately raised this minimum from time to time until today, in some states the minimum branch pipe static pressure must equal 5-in. water gauge. Referring back to equation (1), it can be seen that for an average hood a branch pipe velocity of approximately 6350 ft. per min. would be indicated, while if the hood designer were clever enough to decrease resistance to airflow thru the hood and also increase f, by decreasing the vena contracta effect, in order to have a branch pipe static pressure of 5-in., a velocity of approximately 8000 ft. per min. would be necessary in the branch pipe. Such a condition is obviously ridiculous. Not only is the branch pipe velocity too high, but the designer is penalized for his painstaking refinements in hood design. Static pressure requirements should be abandoned in all state codes since it is not an accurate indication of either branch pipe velocity or hood performance. Where codes not only specify the branch pipe static pressure close to the hood, or the branch pipe velocity, but also the pipe size, then a definite volume

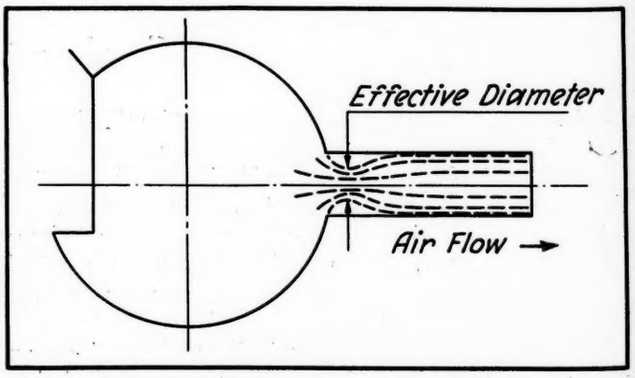


Fig. 1. Diagrammatic illustration of vena contracta effect in sample hood.

of air will be moved (static pressure specification dependent on f), and at least a good attempt has been made to write performance into the code. Far better would be to specify velocities at the face or inlet of the hood, then hood performance would be definitely underwritten. Best of all would be for the state authorities to study the subject exhaustively, as many have done, and issue bulletins from time to time showing the latest hood and exhaust system developments, and recommendations for hood face velocities, branch and main pipe velocities, filtering velocities, piping material and construction, and other items of design. As for definite requirements, the writer feels very strongly that the codes should limit themselves to the thing that counts, the final result. After the system is in, a quantitative and qualitative analysis of the workroom should be made and only when good health standards have been met should any system be approved. This is exactly the condition in at least one state. Other states are heading in this direction.

To explain further the writer's statements against the specification of high velocities, first let us examine some of the fundamental equations relating to airflow in piping. (For the purposes of this derivation, all units may be conveniently disregarded in all of the several formulas which follow.)

From Fanning's formula for resistance to turbulent air flow in round piping

$$R_p = f \frac{2LV^2}{gD} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where

R_p = pipe resistance,
f = a friction factor,
L = pipe length.
V = velocity,
g = gravity.
D = pipe diameter.

Referring to equation (2), since we are seeking a relationship between R_p, V, and D, we may restate it as follows:

$$R_p = \frac{K \text{ (a constant) } V^2}{D} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Also, since

$$hp. = \frac{c.f.m. \times R_p}{6356} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where

hp. = air-horsepower necessary to overcome pipe resistance,
c.f.m. = volume of air flow.

Combining (3) and (4)

$$hp. = \frac{c.f.m. \times KV^2}{6356D} \text{ or } \frac{K_1 \times c.f.m. \times V^2}{D} \quad \ldots\ldots\ldots (5)$$

but

$$c.f.m. = AV = \frac{\pi D^2 V}{4} = K_2 V D^2 \quad \ldots\ldots\ldots (6)$$

hence

$$hp. = \frac{K_2 V D^2 K_1 V^2}{D} = K_3 V^3 D \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

TABLE 1. SPECIFICATIONS FOR FLANGED PIPING

Pipe Diam., In.	No. of Bolts	Bolt Size, In.	Angle Size, In.
Up to 4	4	⅜	1½ x 1½ x ⅛
Over 4 to 6	6	⅜	1½ x 1½ x ⅛
Over 6 to 10	8	⅜	1½ x 1½ x ⅛
Over 10 to 12	8	½	1½ x 1½ x 3/16
Over 12 to 16	12	½	1½ x 1½ x 3/16
Over 16 to 24	16	½	2 x 2 x 3/16
Over 24 to 30	16	½	2 x 2 x ¼

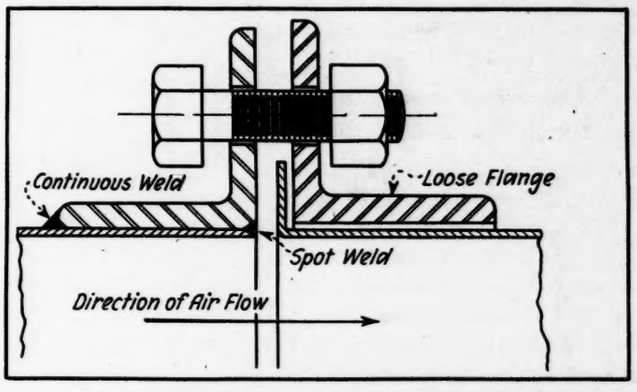


Fig. 2. Illustrating method of making effective flanged joints.

From this relationship it is apparent that the horsepower necessary to overcome the resistance to airflow in any certain pipe section varies as the cube of the velocity and directly as the pipe diameter. Thus if a branch pipe velocity of 4000 ft. per min. were adequate for the material handled, and it were necessary to make the branch pipe 10-in. in diameter to provide sufficient air for good hood performance, arbitrarily increasing the velocity to 8000 ft. per min. to conform to some code, and keeping the branch diameter constant would increase the required horsepower $\left(\frac{8000}{4000}\right)^3$ = 8 times. If it is desired to keep the branch volume constant, decreasing the pipe cross-sectional area proportionately with any increase in branch velocity, the following considerations hold: from equation (6)

$$c.f.m. = K_2 V D^2 \quad \text{or} \quad D = \sqrt{\frac{c.f.m.}{K_2 V}},$$

but c.f.m. is being held constant, hence

$$D = \frac{K_4}{V^{1/2}}$$

Substituting in equation (7)

$$hp. = \frac{K_3 V^3 K_4}{V^{1/2}} = K_5 V^{5/2}$$

So, while it is obviously more economical to keep the volume constant than the branch diameter, in any event it is extremely wasteful of power to specify unnecessarily high velocities.

Especially is this true in view of the relatively low hood velocities necessary for adequate dust or fume control. Very rarely do velocities at the face of hoods exceed 1500 to 2000 ft. per min. Why then, if these velocities satisfactorily control the dust hazard or nuisance, is it necessary to go to 4 and 5 times these figures?

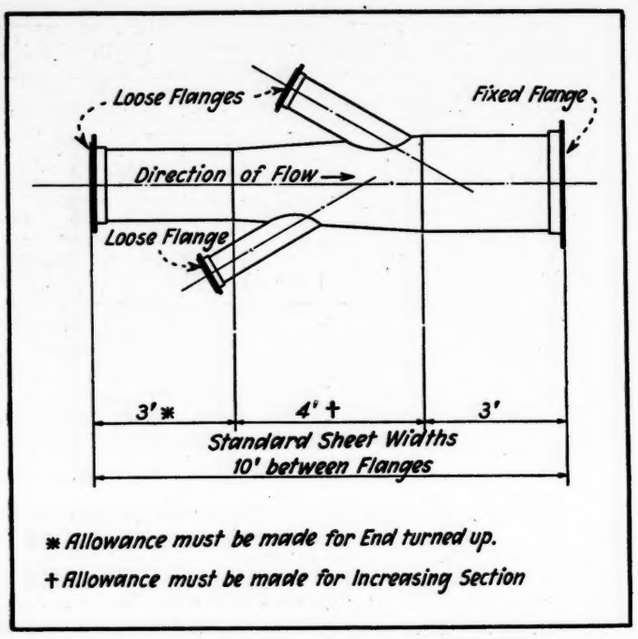


Fig. 3. Illustrating the use of standard width sheets and flanged joints.

Economic reasons preclude enormous pipe sizes, but certainly a balance can be struck which will at the same time give us low velocities and economically sized piping. Summing up, it is the writer's recommendation, and it has been his practice, to design first for adequate hood control, thus establishing the branch volume, and then to figure on a branch and main duct velocity sufficiently high to convey the air-borne material without danger of precipitation, thus establishing branch pipe diameters. Having laid out the remaining components of the system, make a personal visit, if possible, to the proper state bureau and show and explain your plans to the engineer who will finally approve or condemn your system. Explain to him that you have designed for adequate dust or fume control, but that there will not exist the required 3, 4, or 5 inches of suction at the branch inlet, explaining also as previously shown, the utter lack of any need for such suctions and the extreme expense involved in supplying them. It is the writer's sincere belief that regardless of the existing state regulations, an engineer following the procedure outlined would be permitted to erect and operate such a system provided, of course, adequate dust or fume control did finally result.

Piping Pointers

While round pipe is easier, quicker, and hence cheaper to make than rectangular, and is for these reasons and the features of superior strength and rigidity far more prevalent in exhaust work than rectangular pipe, many times for considerations such as building obstacles, fan discharge connections, filter or washer connection, or just appearance, rectangular pipe is used. It is important to make the material thickness at least two gauges lower in number than for the equivalent round piping.

While flanged piping is somewhat more expensive from a material and fabrication standpoint than lap-jointed piping, much of the difference is made up in erection. However, it is necessary that much care be exercised in design since valuable time may be lost in correcting a pipe which may be too long or too short, or in which the branch collar has been incorrectly located. Where there is any degree of permanence at all to a contemplated exhaust system it is recommended that all longitudinal joints, branch collars, and one flange be permanently welded using a continuous weld. Since it is difficult to weld lighter than No. 14 gauge steel, and since a better weld results from the use of black steel over galvanized (due to the absence of the zinc coating), it is recommended that No. 14 gauge black steel be used for all header or main ductwork where it is desired to weld and flange joints. Specifying a single gauge size will result in economies to the buyer. Whether the piping is to go inside or outdoors, it is best to paint its exterior. A spray of aluminum not only offers a good protective coating against rust and corrosion, but enhances the appearance of the entire system. As previously mentioned, it is best to weld one flange, and to leave the mating flange free as in half of a Van-Stone joint where the pipe end is turned up (see Fig. 2). This type of joint with some ordinary roofing cement constitutes an excellent seal against costly leakage. By experience, the writer has found the angle and bolt specifications, as shown in Table 1, entirely adequate and satisfactory for flanged piping in exhaust work.

In general, flanged sections should be approximately 10 ft. long, and should carry flanges at both ends and close to the entry points of each branch to the header. Slip-jointed piping for branches is entirely adequate and is recommended from the standpoint of cost. The ease of maintaining flanged headers, together with the longer life and greater strength, more than compensate for the slightly greater first cost. While flanged piping does not necessarily have to be welded, nor be of heavy gauge, it finds its greatest adaptability in service requiring and justifying all three features of construction.

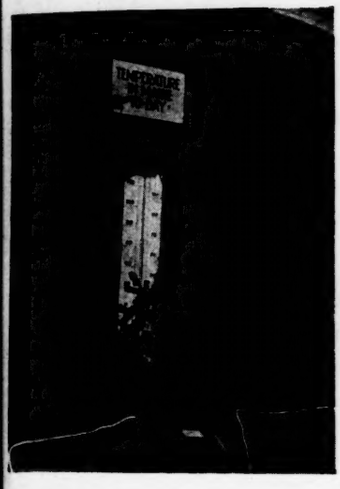
One point generally neglected in piping design is the use of the full width of standard sheets in making up the sectional components of pipe, flanged or otherwise. It must be remembered that an entire sheet must be paid for regardless of how little of it is used, and it is a sad commentary that too often the first cut of the sheet represents the entire use ever gotten from that sheet. In constant diameter piping, the use of whole sheets means a definite time and labor saving for cutting. This point is well to consider as a means of effecting economies in piping fabrication. (See Fig. 3.)

ARCTIC GIRLS. The ultimate in air conditioning is displayed in the Arctic Girls concession in the amusement area where undressed beauties are placed inside hollowed-out cakes of ice for seven minutes at a time.

PANDORA, THE PANDA, at the New York Zoological Society's exhibit at the Fair, is accustomed to cool temperatures, and when the temperature soared Pandora wilted. A Westinghouse suspension type air conditioned installation was arranged for and Pandora is now completely normal.

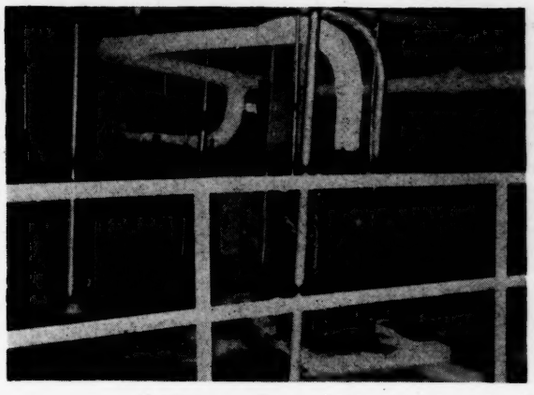
NEW YORK WORLD'S FAIR—1939

On this and the succeeding six pages are illustrated a few of the numerous exhibits and concessions of interest to the air conditioning engineer at the World of Tomorrow.



CLIMATIC PROPAGANDA emphasizes the attractiveness of the Maine climate during the summer.

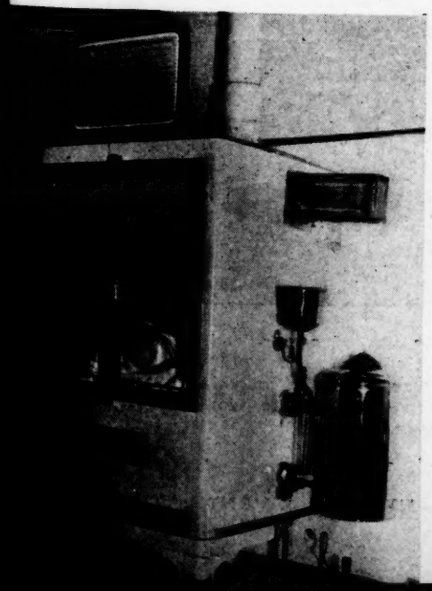
THE REFRIGERATION PLANT shown below freezes ice on the turntable-type ice skating-rink in Sun Valley. The white railing in the foreground is covered with frost formed by refrigerant circulating through the pipe.

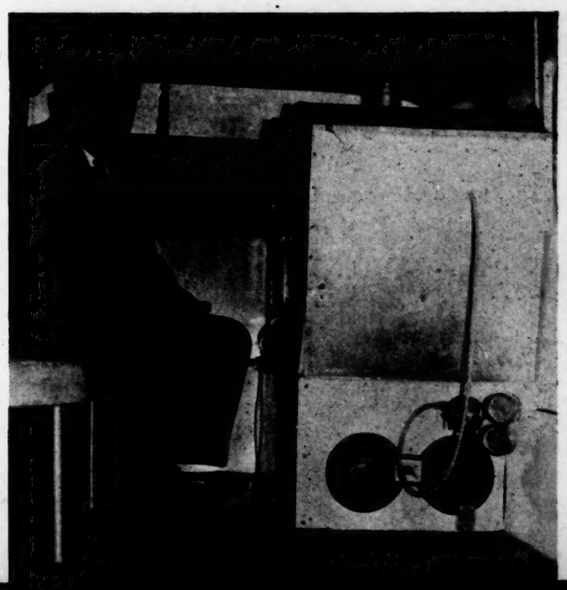


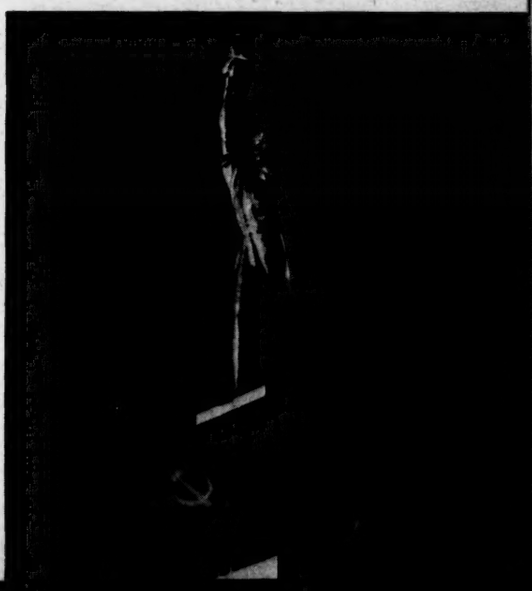
TURNTABLE ICE RINK in the elaborate Sun Valley exhibit. Between shows the floor of the rink is plain wood. Immediately before the show begins the rink floor revolves and the wood floor disappears under the side walls and the ice rink appears.

INCUBATORS FOR BABIES. Approximately two dozen premature infants are kept in individual incubators in a show devoted to these "preemies." These incubators, shown at the left (below), have temperature-regulated gas-fired hot water heating. Temperatures are maintained between 75F and 90F (usually 85F) with relative humidity from 50 to 60%. The air conditioned ambulance, below, (right), is the first and only ambulance ever designed for the transpartation of premature infants. The view shows Dr. Martin A. Couney, the inventor of the incubators. The ambulance unit is heated by hot water supplied from the radiator through copper coils.

VENTILATED STAR. This imposing statue is a feature of the U.S.S.R. exhibit. The red star in the hand is illuminated by a 5000 watt bulb; it emits so much heat that a special ventilating system is required to carry away the heat.



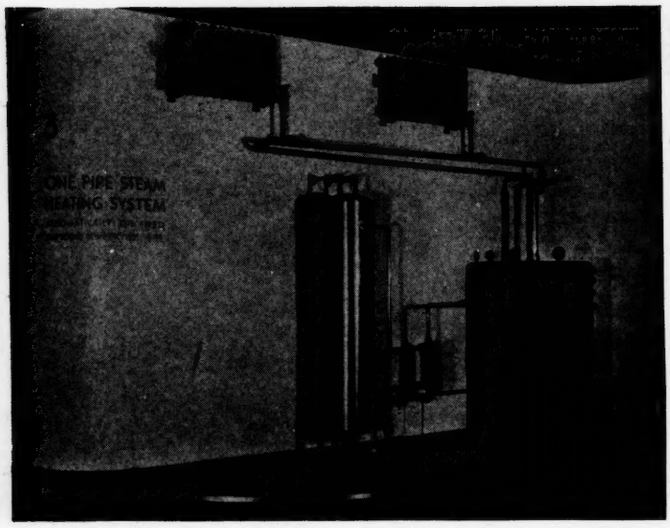




A partial view of the American Radiator Building at the Fair.

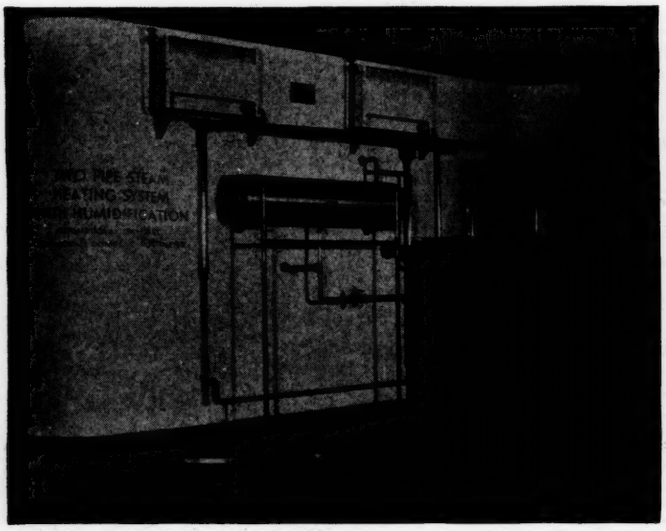
TEN MODERN SYSTEMS

for heating and air conditioning shown at the New York World's Fair by the American Radiator & Standard Sanitary Corporation. These systems, in full size, will undoubtedly accomplish a great deal in clearing up the confusion in many consumers' minds regarding the differences among all of the various types of heating and air conditioning plants available for residential installations. While not all possible combinations are displayed, all of the basic types are shown and other possible combinations would differ only in detail. The company's building itself features use of concealed type radiators and copper tubing as architectural decoration.

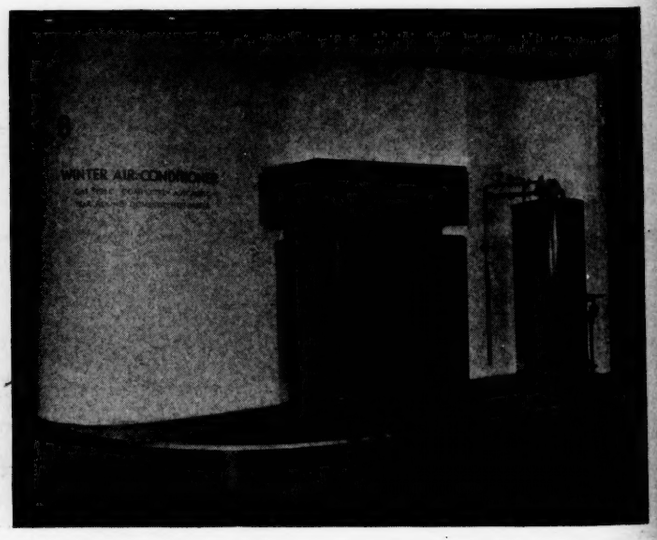


3 A one-pipe steam heating system to which an automatic oil burner has been added and arrangements made for obtaining hot water from the oil burning plant the year 'round.

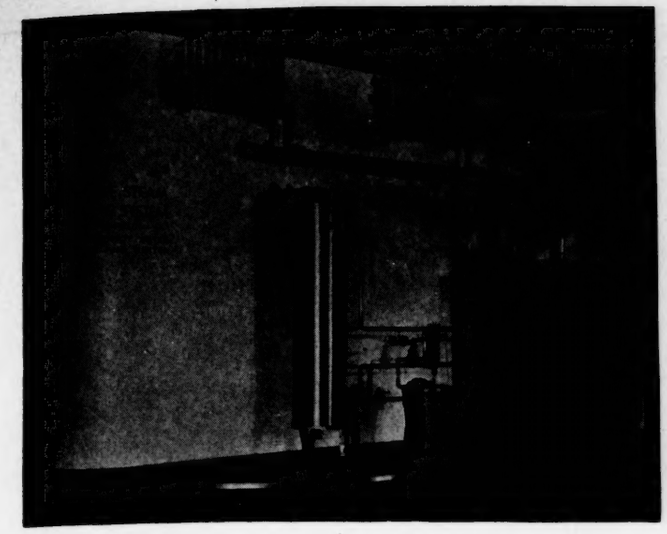
4 Another one pipe steam system, this one having a stoker. Here, too, the heating plant provides hot water the year 'round; the storage tank is of the horizontal type.



7 An oil-fired two-pipe steam heating system with domestic hot water from the heating plant the year 'round. Humidification is provided from steam pipes and introduced to the rooms through grilles in the walls.

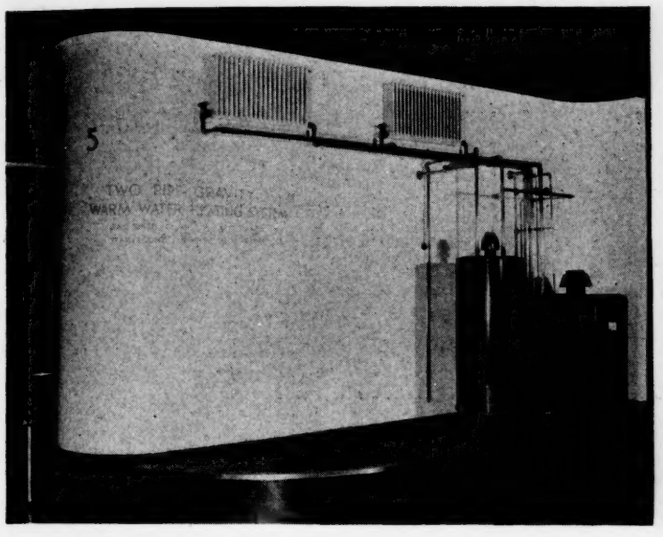


8 This exhibit illustrates use of a gas-fired automatic winter air conditioner. As an auxiliary to this system a gas-fired water heater is provided for year 'round domestic hot water. Ducts would be necessary but are not shown.

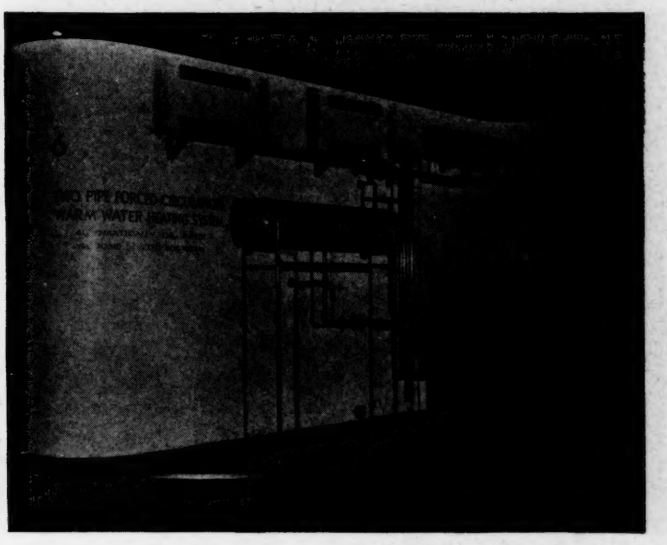


1 A hand-fired coal-fired one-pipe steam heating system, with indirect water heater for winter use and a bucket-a-day heater for summer hot water.

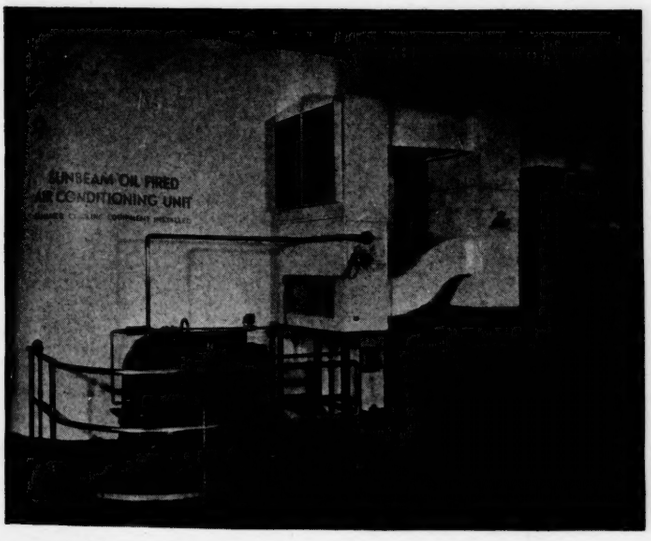
2 A simple hand-fired coal-fired gravity warm air system. The coil in the furnace provides hot water in the winter, a bucket-a-day stove in summer.



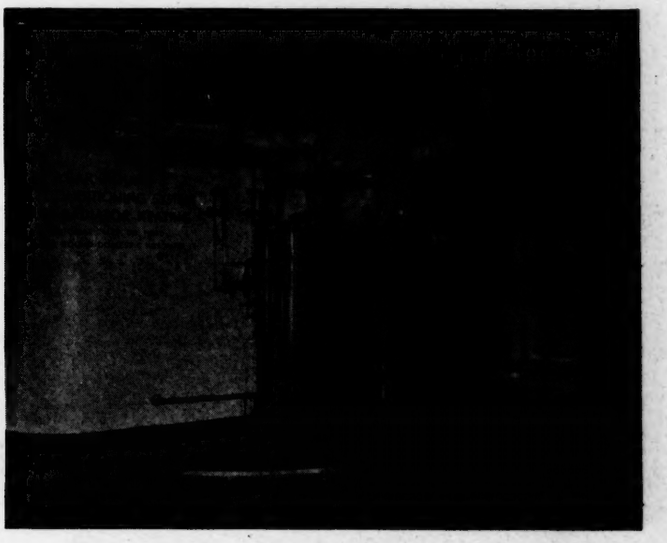
5 A two-pipe gravity hot water heating system with a gas-fired boiler. Domestic hot water is provided separately in summer.



6 A two-pipe forced hot water heating system, with convectors instead of radiators, and using an oil-fired boiler. Domestic water by the heating plant.



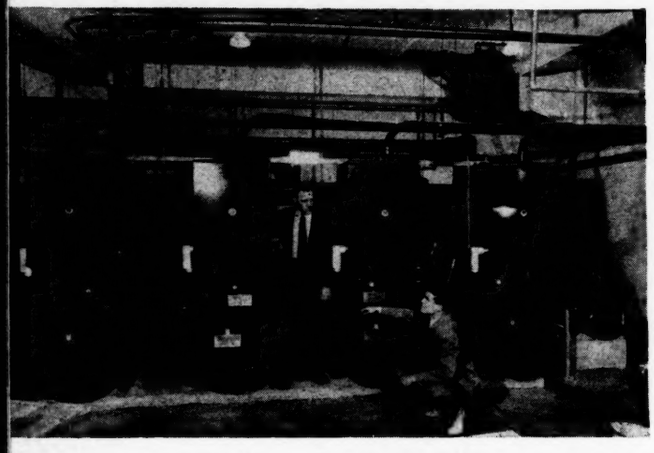
9 An elaborate oil-fired air conditioning plant for winter and mechanical refrigerating system for cooling the air in the summer. Domestic hot water would be provided by a separate hot water unit.



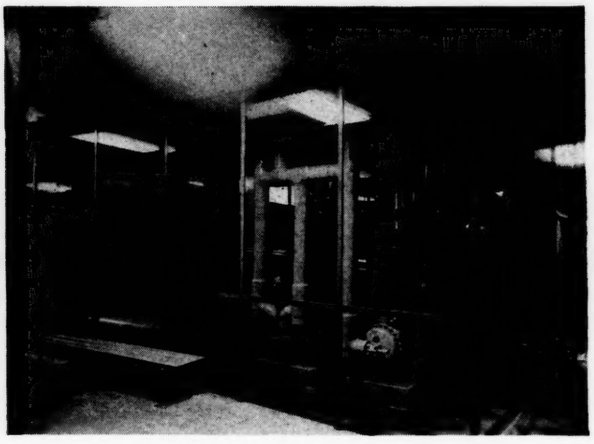
10 A year 'round air conditioning system of the radiator type. The main quarters are conditioned from the unit at the right with heating and cooling coils. Source of cool water necessary.

FROZEN FOREST in the Chrysler building where glittering ice trees provide a beautiful and cool retreat for summer visitors at the Fair. The trees are built of thin sheet metal. The frost is the result of moisture cooled from the air and frozen by contact with the sheet metal which covers a core of tubing carrying refrigerant from the Airtemp cooling equipment.

CONDITIONED CIGARETTES. The American Tobacco Company in its exhibit displays the actual making of Lucky Strike cigarettes. Westinghouse air conditioning equipment (above), maintains 75F at 58% relative humidity to keep the tobacco fresh and to keep comfortable the 30,000 visitors per day.

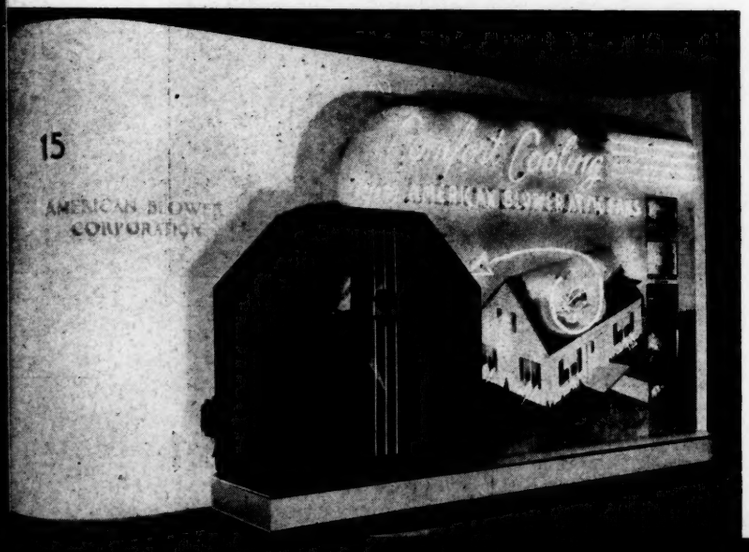


FORWARD MARCH OF AMERICA is the title of the electric utilities exhibit. It is air conditioned by the four compressors shown (above), totaling 185 tons. The condenser water is pumped to a reservoir on the roof where it is not only cooled but reduces heat gain as well, then falls over the side of the building, creating a waterfall effect. Equipment by Westinghouse.



VISIBLE AIR CONDITIONING EQUIPMENT at the Westinghouse exhibit. The principal types of air conditioning equipment made by the company serve a double purpose—display as well as utility. Shown are two 60-ton compressor units operating in parallel with an 80-g.p.m. aquamizer and using two water chilling units.

HUGE ATTIC FAN displayed by American Blower Corporation as part of its exhibit in the American Radiator building. Neon-lighted arrows on a cut-a-way model of a house illustrate air circulation when an attic fan is used.



PYREX PORT HOLES enable Fair visitors actually to see this boiler (below) make steam at the Kewanee Boiler exhibit in the American Radiator building.

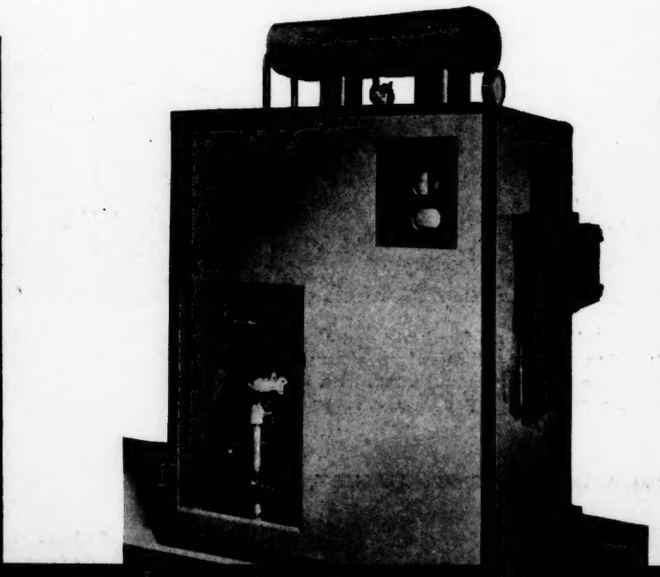
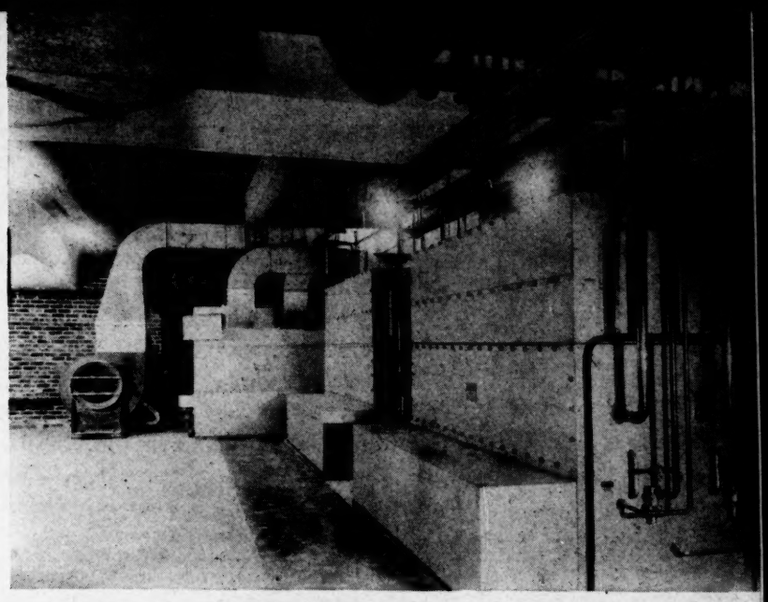


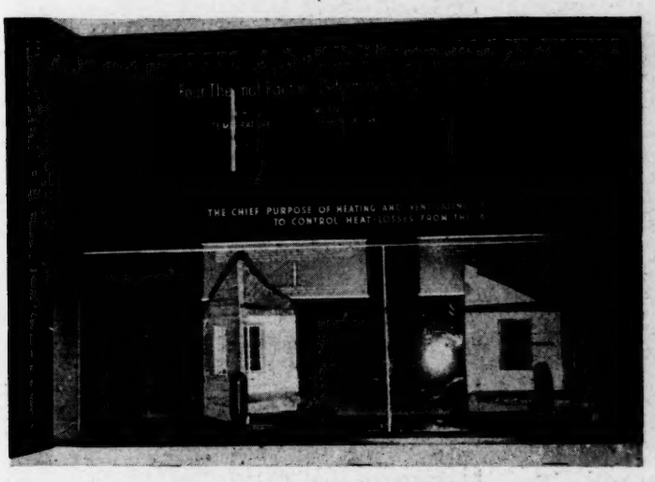
Exhibit Area

Many of the industrial exhibit buildings at the Fair are air conditioned, and of these a number have air conditioning equipment encased in glass so that it is visible to visitors. In addition to the air conditioning itself, the heating and air conditioning engineer attending the Fair will find many of the exhibits dealing with one phase or another of air conditioning. There is hardly a building at the Fair but what includes something to attract the attention of the air conditioning engineer.



EVAPORATIVE CONDENSERS, three in number and shown above, are used in the air conditioning of the Frigidaire exhibit in the General Motors building.

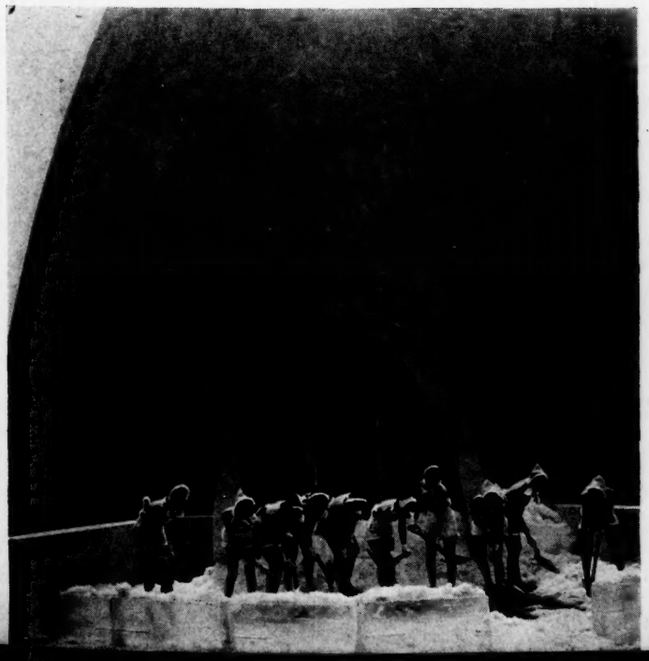
ELECTRICITY DIRECT FROM HEAT. In the Westinghouse exhibit is exhibited a thermo-electric generator which converts heat directly into electricity. A hundred thermocouples of two dissimilar alloys are welded together, with one end heated by a gas flame and the other cooled by room air. Each unit generates a small voltage and all together a sufficient voltage is obtained to operate the small fan.



BODY HEAT LOSS control is the fundamental aim of heating and ventilating the home. The Pierce Foundation of New Haven, in its exhibit in the Hall of Medical Science (above), illustrates this aim and shows the effect of insulation on building walls and the four thermal factors which determine body comfort. Radiant heating is also shown.

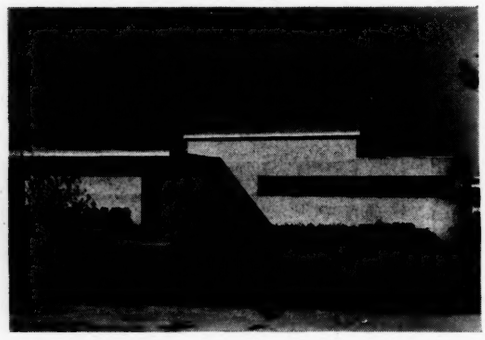
ASBESTOS MURAL. The world's first asbestos mural (below) dominates Keasbey & Mattison Company's exhibit at the Fair. Standing 21 feet high it depicts the "Spirit of Asbestos" protecting the possessions of man from the onslaught of weather. Shown in the inset is the company's "Fiery Snow Man," a figure made from snow, sitting on top of a flame-filled chamber at 800F. A slab of asbestos magnesia insulation protects the snow man from the heat.

SNOW MAIDS SHOVEL SNOW in front of the Carrier igloo at the Fair. The photograph was taken as the thermometer registered 98F in the sun.



THE TOWN OF TOMORROW

Consisting of 15 model houses, the Town of Tomorrow includes six dwellings of modern design and nine in traditional styles. About 5000 people visit this demonstration each day to observe the last word in home building design, construction, and decoration. Some of the houses include radiator heat, others have warm air systems. Shown here are nine of the houses on display, together with some views of the heating equipment. The Town of Tomorrow is supplemented by the Home Building Center in which heating (and other) equipment is exhibited in the usual exposition manner.



PLYWOOD HOUSE. Demonstrates the many and varied uses of plywood in home building. A feature is the large high-ceilinged living room. The front door leads directly into the living room. The cost of this house is estimated at $4500.

DOUBLE DUTY HOUSE, so called because its living room serves as a bedroom at night and its high windows permit use of the living room as a solarium in daytime. The garage is also a recreation room. Cost estimated at $5000.

JOHNS-MANVILLE HOUSE, triple-insulated, offers a high degree of fire safety and has rock wool between studs and ceiling and between second floor ceiling and attic. Designed for a family of moderate income. Cost estimated at $9500.

SMALL HOME OF WOOD. A traditional design house intended as an exhibit of the lumber industry. Has fewer but stronger structural members than the usual frame house. Intended for a family of six. Cost estimated at $3000, including garage.

GARDEN HOME designed by a woman architect impresses many women visitors. Estimated cost $13,000.

DINING ROOM of the Garden home. Underneath the wide expanse of windows is shown a Rome Tourney radiator.

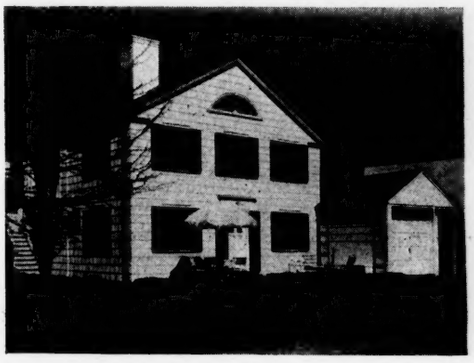
HEATING and air conditioning plant in the Electric Home, next page.

ELECTRIC HOME sponsored by General Electric Co. includes their heating and air conditioning unit. Illustrates complete electrification of the modern home. Cost estimated at $17,000.

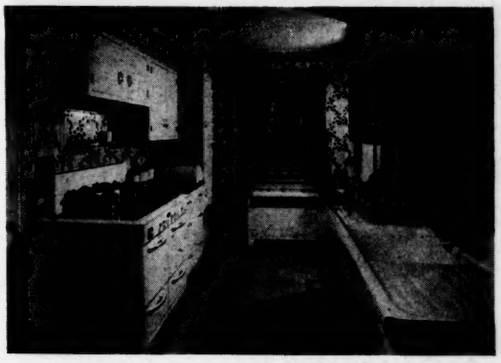
BEDROOM of the Electric home. Webster system radiation is used throughout this house. One of these unobtrusive units is installed beneath the window to the left. All convectors but one are concealed.

THE MOTOR HOME. A two-car garage forms the main entrance to the house. Ornamental garage doors when closed act as decorative panels. Intended for a family of four. Estimated cost $22,000.

DINING ROOM of the Motor home with Georgian furniture and other traditional treatment. The radiator shown under the left hand window is a Weil-McLain Raydiant. Kitchen has an Ilg ventilator.



NEW ENGLAND HOME. Has an upstairs porch and other modern features, although designed for traditional. Cost, $10,000.



KITCHEN in New England home showing Modine convector under window. Convectors used throughout.

KELVIN HOME sponsored by Kelvin Corporation has year round air conditioning. Estimated cost $15,000.

BEDROOM in Kelvin home showing Anemostat conditioned air outlet in the ceiling.

AIR CONDITIONING plant in Kelvin home. Coils, filters, and fans in foreground, boiler to the right.

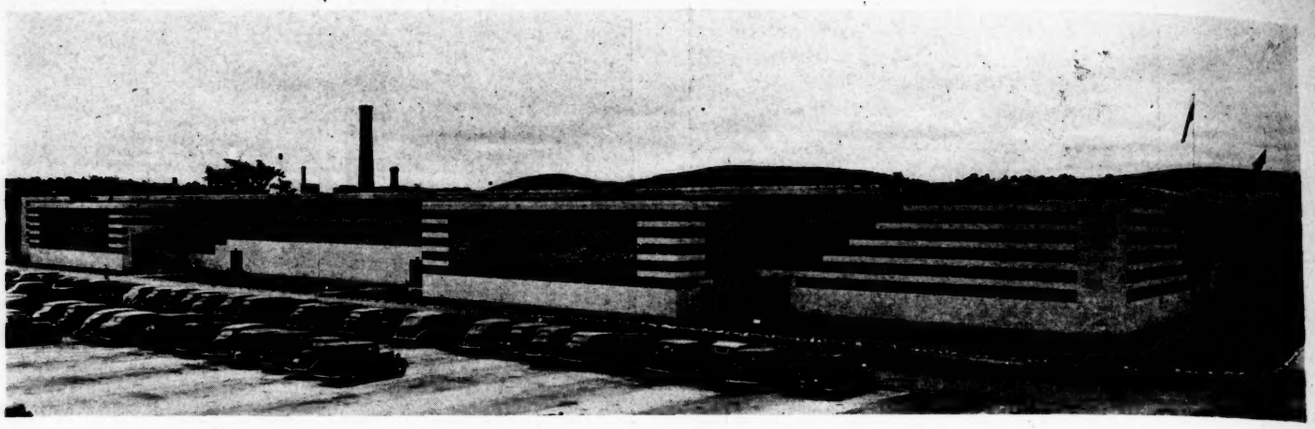


Fig. 1. Exterior of the new 5-acre factory building of Simonds Saw & Steel Co.

Windowless Factory Has Conditioned Air and Controlled Industrial Exhaust

DELAYED seven years by the depression, the new plant of the Simonds Saw & Steel Company at Fitchburg, Mass., covering a space of five acres in one enormous room, is now in full operation. The new plant, housing operations which previously occupied three older plants in Fitchburg and one in Chicago comprising 17½ acres, is a single, windowless room, fully air conditioned the year round, with the most modern scientific lighting and many special features new to industrial operations.

Everything from incoming of raw metal, forging and heat treating of steel to the sharpening and shipping of saws, machine knives, files and other cutting tools made by this company is now handled in straight line production, with the plant operating on two 8-hr. shifts, five days a week, as planned when the depression interrupted the development in 1931, after walls and roof were up.

Nine major production lines extend the length of the plant with all service lines, including water, gas, steam, electric power, light, air and oil carried direct to more than 1000 machine and furnace locations.

Outer walls are of buff colored face brick with used common brick, arranged in a design with contrasts which emphasize the horizontal sweep of the structure. A dead air space is provided between the inner and outer walls, the inner walls being of acoustic type cinder block. Daylight is excluded by these solid walls without a window, thus permitting complete control of illumination, air conditioning and ventilating without variation, day or night the year round.

The roof is of special design which gives maximum insulation with a minimum of weight. The underside of the ceiling is of perforated metal of hollow rib design, into which slab cork has been placed. This in turn is covered by two ½-in. layers of insulation board in staggered arrangement and the entire roof is topped by a 15-year waterproofing. A 4-ft. steel-railed catwalk, a quarter-mile long, is suspended from the trusses and affords means of observing operations through the plant.

More than 1400 fluorescent tubes of 100 watts each throw a blanket of *cold light* over everything, eliminating shadows and supplying 20 to 25 foot candles of light to the working plane from all directions. Curved porcelain reflectors, each carrying a 100-watt tube, are mounted 16 ft. above the floor. To increase visibility and safety many of the machines are painted a bright yellow while the furnaces are covered with bright aluminum paint.

Visitors moving along the catwalk can see men working cold steel at anvils in perfect comfort a few steps away from glowing furnaces, while other workmen in the next aisle are tending huge wet grinders and engineers are working over drafting boards in the distance. Each operation required special facilities in the old plants, such as a special vented building for heat treating; a special kind of floor for the wet work, and a quiet room for the drafting. Now the 700 employees all work in one vast room. Only 80% of the space is required for accommodation of the activities of the former Fitchburg and Chicago plants, the remainder being available for future growth. The new factory is the largest and most modern saw and knife plant in the world, 562 ft. long by 360 ft. wide.

The Main Air Conditioning System

The main air conditioning system, of the evaporative type, consists of four units each housed in lean-to structures 94 ft. long by 28 ft. wide, located at short distances from the four corners of the building. Lockers, lavatories, wash rooms, coat rooms, a ladies' lounge and a hospital are also located in these smaller struc-

tures. A separate ventilating system, automatically controlled, drawing air from the interior of the plant and exhausting it to the outside, is provided for the wash rooms and toilets.

Each of the large air conditioning units has its own control panel, located on columns in the working areas. Together the four units circulate 400,000 c.f.m. through 3000 lin. ft. of overhead ducts, to provide at least five complete air changes per hr. Ducts for the air conditioning system are carried on the bottom chords of the trusses. At units Nos. 1 and 4, they are 90 x 68 in. at the fan discharge; at Nos. 2 and 3, the fan opening is 84 x 64 in. Duct work for the air conditioning totals 63½ tons. From the fan discharges the ducts taper to 26 x 20 in. at the outlets farthest from the fan units. They are made of copper bearing steel, varying in gage from No. 16 to No. 20, depending upon the cross-section dimensions.

Air comes in through louvers on the end walls of the building, after being humidified in winter, or cooled in summer by being blown through water sprays. There are 107 supply grilles. As each of the four conditioning units, operating separately, serve different sections of the building, there are no cross-currents or eddies of the input air to disturb the workers or operations.

General Operating Plan of the A.C. System

As previously stated, each of the four units serves a definite area, each with its own controls. There are two fans handling 10,000 c.f.m. drawing air from units Nos. 2 and 3 also, to send air through underground ducts and the floor to particularly hot zones. This is in addition to the overhead input. These are called *man coolers*, of which more later.

Air conditioning station No. 1 handles 109,500 c.f.m., Nos. 2 and 3 each 90,500 c.f.m. and No. 4 the same as No. 1. Up to 100% fresh air can be circulated by each of the units. The entire system is automatic, with manual starting, and is planned to operate on a 24-hr. basis if required. Fan motors are 75 hp. each for stations No. 1 and No. 4, and 60 hp. for stations 2 and 3. There are also two 7½ hp. fans for two smaller auxiliaries.

Relative humidity in winter is kept at 50%. Inside temperature in winter is to be maintained at 68F and in summer will not exceed 16F below outside temperature. Heat gained from furnaces in operation is estimated not to exceed 8,301,950 B.t.u. per hr. and from other operations and material not over 4,438,000 B.t.u. per hr. Air exhausted through vent hoods will not exceed 53,000 c.f.m.

Well Water for Cooling

Four wells were drilled outside the main factory building, near the four corners, to supply water for the cooling sprays and for other industrial purposes. These vary from 8 to 12 in. in diameter and in depth from 25 to 64 ft. At each well is a pump pit equipped with

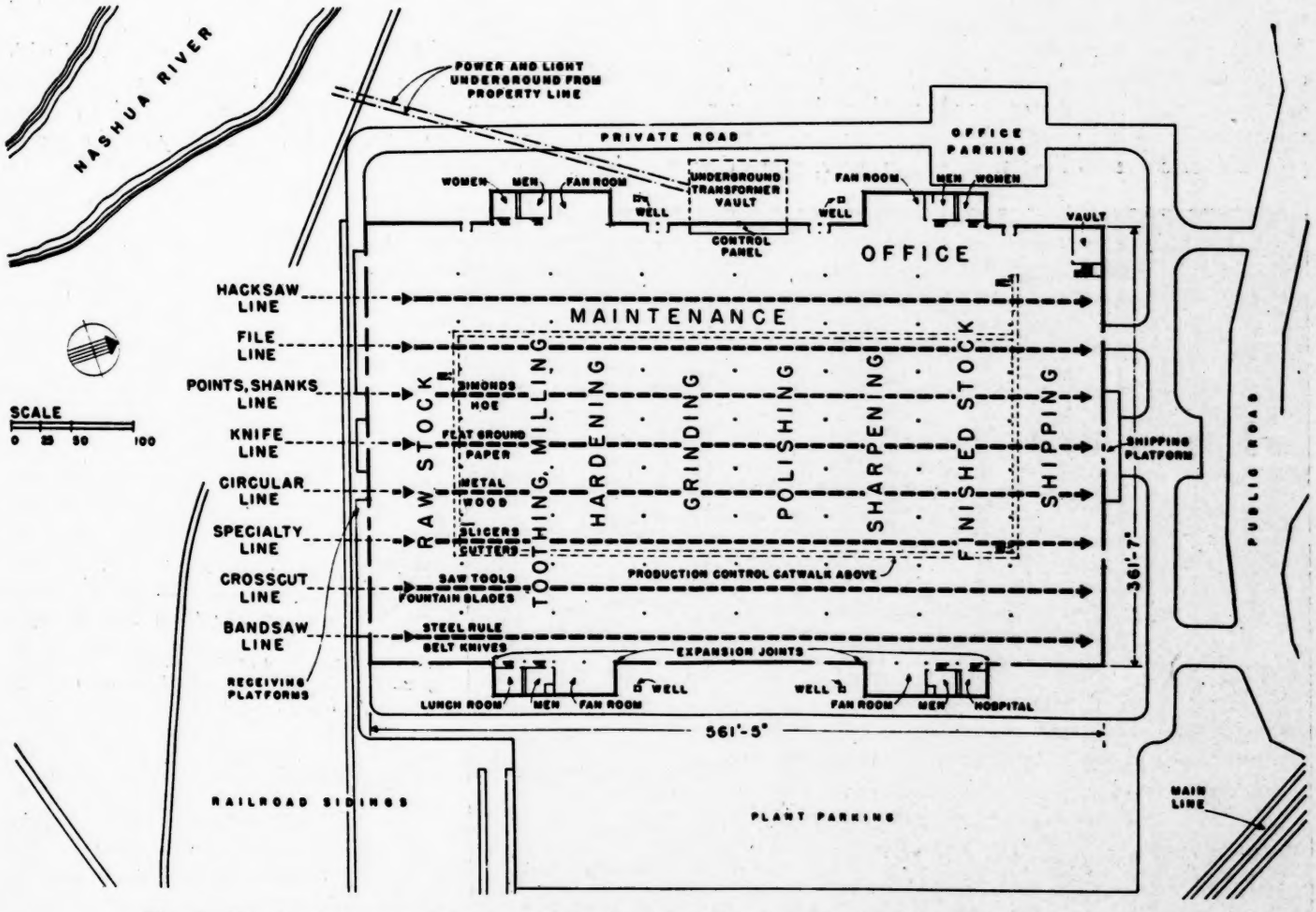


Fig. 2. Manufacturing operations, maintenance, and office space are all provided for on one floor without partitions. Layout permits straight line production.

Fig. 3. One of the four air conditioning units each installed in lean-to buildings at the sides of the main building.

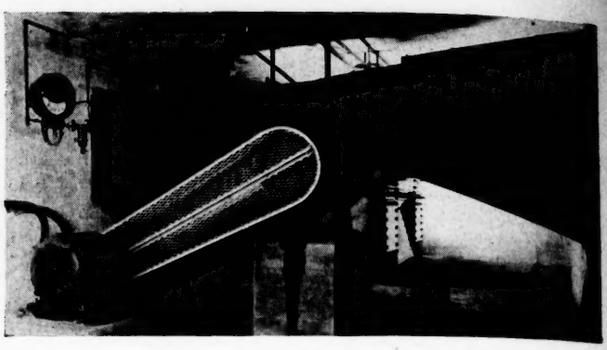


Fig. 4. One of the exhaust fans located in a pit below the floor. Full exhaust is provided throughout the plant.

a water lubricated deep well turbine pump, with a total capacity for the four of 1025 gal. per min., divided as follows: 150 gal. per min.; 275 gal. per min.; 300 gal. per min. and 300 gal. per min. Pumps are equipped with a linestart motor and with an oversize thrust bearing operating in an oil bath. Water flows at 52F.

The Man Coolers

As mentioned, air is forced underneath the floors from the four conditioning units to *man coolers* located at the furnaces and other hot spots, thus moderating the temperature at these places and displacing the hot air up into the curtained areas above them, where the used air is exhausted through some 42 roof ventilators. All furnaces are highly insulated to an extent which permits laying the hand on the surface of the insulation without experiencing a feeling of high temperature. Aprons extend from the ceiling to the bottom chords of the roof trusses to trap the heat at its source. The extremely rapid exhaust of air above these heat sources maintains conditions throughout the plant, despite the presence of some 70 heat treating furnaces, more than 1000 individual motor driven grinders, cutters and other machines in almost constant operation.

These *man coolers,* especially designed for the Simonds factory by The Austin Company, represent a new development in air conditioning for the industrial field. They are planned to use either fresh or recirculated air.

Built of heavy iron and painted aluminum color, they stand about 10 ft. high, with a hood fitted with a directional vane type of discharge grille mounted on the top. The tops can be turned with a clamp, travelling on a collar, so that the air flow can be directed to any point within the area of the particular cooler. If one furnace is idle in the area supplied by a cooler and another furnace needs the cooling, the hood and grille can be turned in the desired direction, or, if desired, in line to take care of two furnaces in an area.

There are 9 of these *man coolers,* all connected with the air conditioning system by means of underground ducts. Aprons over the furnace areas lead to ducts opening to vents on the roof, which carry off the excess heat.

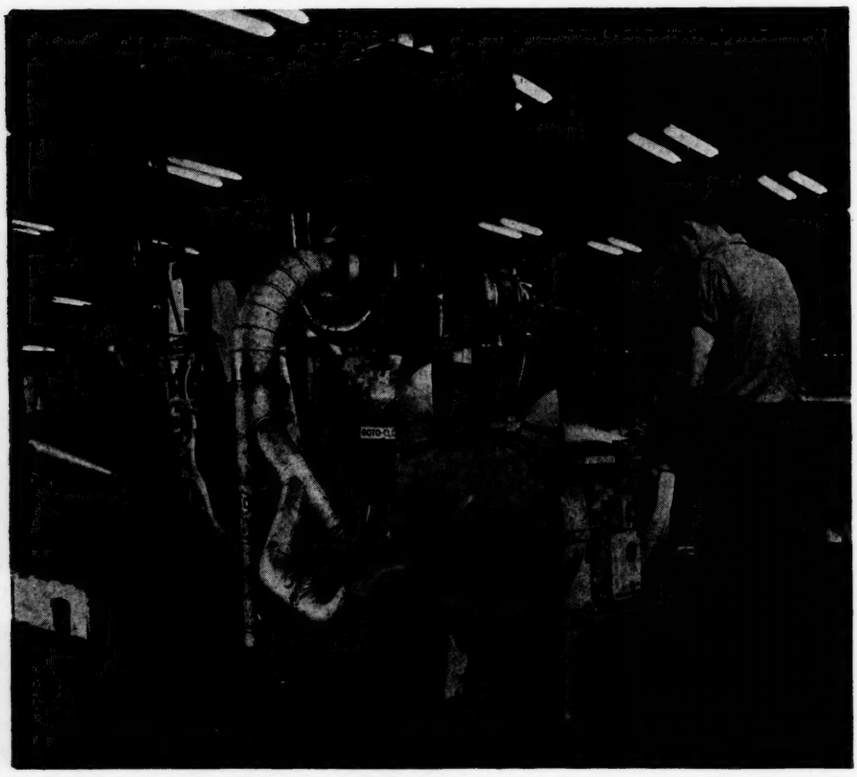


Fig. 5. One of the many dust removal units. Hoods gather dust particles and convey them through pneumatic tubes to the filters where the particles are removed. The dust-free air is then returned again to the factory space.

The Exhaust System

There is also an underground exhaust system in three sections, with suction fans to draw gases directly to the outside from 63 separate locations. Three multivane fans, one in each of three small fan rooms in concrete basements take care of these exhaust ducts. While hundreds of emery wheels throw off sparks and dust, in the grinding of saw teeth and knives, the air is kept clear of such particles by 28 dust removal units serving hundreds of machines. These units filter the air and then recirculate it. Each of these air cleaners uses from 4 to 6 filters. Dust removal ducts are of galvanized sheet iron, enclosed in tile, with dimensions of the pits and lengths of the duct sections co-ordinated to permit easy replacement.

Steam sand blasting machines operating at 100 lb. pressure on file making create dust of fine sand and steel particles, which is carried off by four units to each machine, up through the roof to outside air. Other air sand blasts, using beach sand, for high speed cutters to take off the scale from the steel, also have exhausts to the roof.

There is a cyclone separator in the shipping department, where shipping cases are made, to carry off the finer dust from the sawdust and cutting direct through the roof to discharge its cleaned air to the outside, while the heavier material drops to the bottom of a tank and is cleaned out periodically.

Smoke is emitted from the polishing machines, sometimes with a bad odor, and this also is exhausted through other pipes to the roof.

Steam Supply

Steam required for processing and for winter heating is provided at 100 lb. pressure by three boilers rating 225 hp. each, available in a separate boiler house acquired with the factory site.

Seven and One-Half Miles of Piping

Approximately 7½ miles of piping are required to carry water, gas, steam and other services to the production equipment. About half of this is under the floor and the rest is carried in the roof trusses. Included are 10,000 ft. of cast iron, 7000 ft. of welded steel, 10,000 ft. of black iron, 5600 ft. of galvanized iron and 6000 ft. of brass pipe. This great mass serves the nine major production lines extending the length of the plant.

Special power ducts totaling 17,000 lin. ft. are installed on 10 ft. centers through the plant, with access openings every 2 ft. Some 60,500 ft. of galvanized iron conduit were used to house about 30½ miles of wire and cable. The plant has a connected power load of 6000 hp. and a total of 4200 electric outlets. All power entering the plant is controlled through a 66 ft. totally enclosed *dead front* steel main switchboard located just inside the west wall beyond which transformer banks and switch houses are located.

Since this plant was first conceived and the exterior built, many of the ideas embodied in its design and the new equipment originally planned have been tested out elsewhere and proved successful. The original idea of building this windowless factory was to provide working conditions for employees which would equal those of any executive office. It was found through experience that in the ordinary plant having windows the amount of light varies with the seasons as well as on bright and cloudy days. Also that noise is disturbing to workmen, hence anything that could be done to eliminate noise would lessen the strain on the operators. Therefore it was decided that the nearest approach to ideal conditions for the employees could be obtained through a windowless plant.

Much study and effort went into models and layouts before any construction was attempted. Every operation was analyzed and the functions of every employee and every piece of equipment were studied. Every workman was asked to tell what he thought the ideal plant should be like and how it should be laid out. When all suggestions and ideas gathered from many sources were sifted and coordinated, the plans for the factory emerged.

Architects, engineers and general contractors, The Austin Company; air conditioning, Carrier; wells drilled by R. E. Chapman Co.; piping by The Jennison Co.; flue exhaust hoods, ducts and man-coolers installed by Fitchburg Sheet Metal Co. All photos by courtesy of The Austin Company.

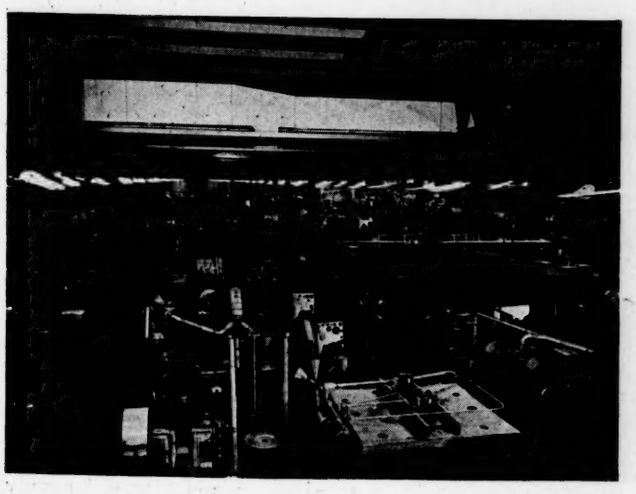


Fig. 6. The air conditioning ducts under the ceiling and one of the special dust-handling equipments in the foreground can be clearly seen.

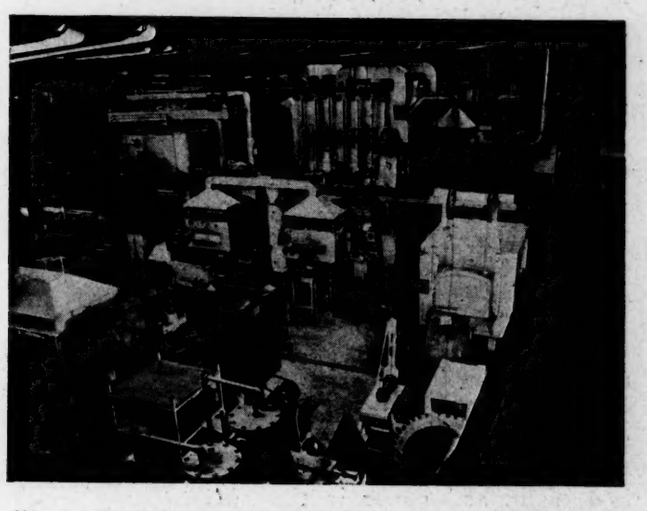


Fig. 7. Hooded furnaces with ductwork connecting them to the exhaust system can be seen in the middle foreground and also in the upper right hand corner.

Solar Heat Boiler Further Developed

WAYS of storing the almost infinite energy which the sun pours on the earth's surface, and a highly efficient solar engine which will supply power at a cost of about a half cent a horsepower-hour are described by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, in a report on the latest phases of his sun power researches just issued.

Solar power utilization now is just approaching the practical stage where, in certain limited fields at least, it may compete successfully with coal or water power. The proposal would utilize a solar heater, several types of which have been invented by Doctor Abbot, which would catch the sun's heat. His friend, Dr. F. G. Cottrell, suggests a silo-shaped, cement-lined pit in the ground, filled nearly to the top with dry, loose sand and roofed over. Above the sand would be placed a layer of glass wool, a very poor heat conductor, approximately 10 ft. thick, such as is used for roof insulation.

Then, as the proposal is reported, "a pipe leading from the solar heater to the center of the upper surface of the sand has an appropriate network of branch pipes covering the surface. A similar network at the bottom of the pile leads to an outlet pipe, and thence runs back to the heater. An automatic pump which runs only while the focus tube is hot draws hot air through the solar heater into the top of the sand. Owing to the notoriously bad conductivity of dry sand, and the high degree of protection from upward convection and conduction offered by the thick layer of glass wool, the sand pipe receives the heat and keeps it in a horizontal layer. The heated layer gradually works down till, if the storage operation is very long continued, the whole sand pile becomes of nearly as high temperature as the air in the focus tube itself. With a sand silo of sufficient capacity, Doctor Cottrell thinks the efficiency would be so high that when the heat was drawn away, perhaps months later, by reversing the circulation of air, the air would come away from the top of the sand very nearly as hot as it formerly entered."

Most of the report is concerned with the progress of Doctor Abbot's researches in the utilization of solar energy. With a 15% conversion into mechanical energy, he points out, the state of New Mexico alone could supply from solar radiation more than 10,000,000,000,000 hp-hr. of power per year—equivalent to the power possibilities of all the coal, oil, and water at present used for heat, light, and power in the United States. If ways of efficient conversion and storage can be devised, this direct utilization of sun energy, from which even now is derived indirectly nearly all energy known on earth, is likely to be a dominant factor in the life of the future, when coal approaches exhaustion and all the available water power is utilized.

Dr. C. G. Abbot, secretary of the Smithsonian Institution, and his latest solar heat boiler.

Doctor Abbot's most recent researches have been on the improvement of his solar flash-boiler engine—that is, an engine with a single tube boiler protected from heat losses by an elongated glass vacuum jacket and fed by a current of water automatically graduated in flow by the temperature of the boiler. With this device it is possible to raise full steam pressure within five minutes after exposure to the sun. Should the sun enter a cloud, the water supply is automatically shut off. Should the steam pressure rise above the desired maximum the water supply is increased. Thus the boiler takes advantage automatically of all the clear sky that comes between clouds. It is, in part at least, an answer to the objection that sun power would be very spasmodic, since it would be cut off every time the sky was darkened. The solar flash-boiler, Doctor Abbot's calculations show, would be quite efficient, converting into mechanical power somewhat over 15% of all the energy of radiation striking its mirror. Power, he calculates, could be generated in this way at a cost of about a half cent per horsepower-hour. He refers briefly to the commercialized domestic water heaters, already widely in use in California and Florida, and proving cheap and practical.

The real significance of the solar energy conversion work lies in the possibilities and needs of the future. The objection which at first thought comes to everybody is that, regardless of the enormous energy which the sun is pouring on the earth, the supply is intermittent—shut off at night and on cloudy days, and, in northern sections, greatly reduced in winter. But the outlook is far from hopeless, Doctor Abbot shows. Doctor Cottrell's heat storage suggestion is one way out of the difficulty. Another is chemical storage by the electrolization of water, and saving the hydrogen to be burned in air with boilers to generate steam. Still another way would be to pump water during the summer to a high level reservoir, to be used in a hydro-electric plant later. Possibly best of all, says Doctor Abbot, "would be heat storage within a pressure tank filled with water and surrounded with a thick envelope of glass wool. The water, heated far above the boiling point, would supply steam during cloudy hours or during the night."

Paper on Heating of Low Cost Homes a Feature of ASHVE Meeting

Held on historic Mackinac Island in the Straits of Mackinac in Northern Michigan, the 1939 semi-annual meeting of the American Society of Heating & Ventilating Engineers attracted nearly 275 members, their wives, guests and children. The Michigan Chapter and Western Michigan Chapter acted as joint hosts.

Golf, fishing, horseback riding and carriage trips in addition to the usual indoor social activities in charming surroundings, with headquarters at the Grand Hotel, reputedly the world's largest summer hotel, combined with the high quality of the papers presented, made this convention both a recreational and technical success.

J. F. McIntire, President ASHVE.

W. G. Boales was general chairman of the convention committee which included S. H. Downs, C. R. McConner, B. F. McLouth, F. J. Linsenmeyer, W. C. Randall, and J. H. Walker. Summaries of the papers follow:

COOLING TOWERS

A progress report on research at the University of California by Prof. L. M. K. Boelter revealed tentative results on the evaporative cooling project dealing with drop dynamics which will be eventually augmented by the application of these data to the mass and heat transfer phenomena. Unique instruments designed and built for this study include a hair hygrometer for the determination of space distribution of humidity, a thermocouple psychrometer designed for free convection circulation and possessing a wick diameter of less than 1 mm., a radiometer to measure the rate of energy radiated by the tower under operating conditions, and a pressure plate anemometer, having a natural frequency of moving parts sufficiently high to measure the velocity fluctuations which will be effective in the cooling of a water stream.

Models of the full-scale atmospheric towers placed in a wind stream of known turbulence permit studies of air flow through the equipment. Air-free water is being used to determine the effect of dissolved gases. Several ratios of cooling towers have been proposed based on the concept of an air heating device and of a water cooling device, all of which is important in making available design data of fundamental importance.

VAPOR TRANSFER

Assumptions have been made that the laws for vapor transmission are similar in form to those governing the flow of heat through the walls of a building. Not all of the laws governing the flow of vapor through materials have been demonstrated by experiment, but data indicate that in many cases the flow of vapor through the material is proportional to the vapor pressure drop along the path of flow. From the nature of certain materials and from the fact that vapor may be condensed either by lowering the temperature or by changing the hygroscopic property of the material it is evident that there will be many different conditions under which the flow of vapor may not follow a simple law. A theory covering vapor transfer through materials was outlined in a paper by Prof. F. B. Rowley of the University of Minnesota.

When vapor accumulates at any point within a wall it is due usually to the fact that the vapor travels through the warm section of the wall to the accumulation area at a greater rate than it travels from this area to the cold side of the wall. The rate at which vapor travels from the warm area to the inner section of a wall may be reduced first by lowering the relative humidity and second by introducing some material with high vapor resistance on the warm surface of the wall. In the past it has been common practice to use a building paper or some similar material on the outside surface of a wall to protect it from free moisture in contact with the outside surface and to reduce air leakage through the wall. Recently many of the building papers have been improved and are now good vapor barriers, thus preventing the escape of moisture which may pass through the inside surface into the wall.

COMFORT COOLING

Comfort tests conducted at the Federal Reserve Building in Washington, D. C., confirms previous observations made in Minneapolis, San Antonio and Toronto, Canada, to the effect that a practice of maintaining 71F effective temperature indoors with a tolerance of plus or minus 1F will satisfy practically all groups, according to a report by the society's research laboratory staff headed by F. C. Houghten. Since 1935 the laboratory has been studying the cooling requirements of persons seated at rest or engaged in sedentary occupations in summer cooled and air conditioned spaces. After a careful study of all the data it seems apparent there is a consistent desire for lower temperatures in Minneapolis and Toronto than in the other cities under observation.

Data collected in all these investigations apply to persons entering a cooled space and remaining for 3 hours or more, which may be construed as permanent occupancy. No serious shock was reported in any of the suggested effective temperatures to be maintained, and in those cases where shock was noted the experience would be the same whether entering the cooled space for 5 min. or for permanent occupancy. Hence, the same conditions as maintained for permanent occupancy should give satisfactory results for occupancy

of shorter duration. However, for shorter periods of occupancy the people may be reasonably satisfied with the sensation of coolness acquired during the short period of time, and for that reason higher effective temperatures may be maintained which would, of course, be more economical from the operating standpoint.

CONVECTORS

Results of cooperative research between the University of Illinois and the Society were reported dealing with the effect of inlet and outlet design on the heat output of convectors. This work was carried on by Professors A. P. Kratz and M. K. Fahnestock and E. L. Broderick, all of the University. Data obtained from these tests indicate that the free area of a grilled inlet should be at least equal to, and of an ungrilled inlet should be approximately 25% in excess of, the free area through the heating unit. For maximum heat output the free area of a convector outlet should not be less than 10% nor greater than 30% in excess of the free area through the unit.

Directing vanes installed at the inlet to a convector are not effective and may prove detrimental by introducing additional friction. It was found that the most effective position for a directing vane at the outlet is in a central location with respect to both the cabinet and the outlet face.

Heat outputs of convectors may be from 9.5 to 14.5% greater with a top outlet than with a unit having a front outlet with the same grille free area. Convectors may be converted into humidifiers without loss in effectiveness as a heating device by installing a water pan provided with steam space in the top of the cabinet.

RESIDENCE COOLING

Where the initial cost of a residence cooling installation is more important than the maintenance of ideal indoor conditions, it was determined through tests conducted in 1938 at the Research Residence of the University of Illinois, that a small capacity condensing was feasible. A cooling capacity of 18,000 B.t.u. per hour was found to be sufficient for both stories of the residence on days where the maximum outdoor temperature rose to 95F and the minimum outdoor temperature during the night preceding the test did not exceed 71F.

Satisfactory cooling on both floors of the Research Residence was accomplished by the introduction of cooled air on only the second floor. However, the general application of this principle may be limited by the room arrangement on the first story and the location of the return air grilles as well as the location of rooms remote from the stairway.

Studies made with heat-flow meters indicated considerable discrepancy between measured and calculated values, and it was further noted that thermal equilibrium was never attained in a wall section under actual conditions. The application of insulation to the residence's frame wall construction reduced the heat flow rate, but the magnitude was much less than indicated by the ratio of the calculated coefficient of heat transmission for the insulated and uninsulated walls. The temperature of the inside wall surface was greatly reduced with the use of insulation which resulted in conditions more conducive to comfort for a given air temperature than those produced by an uninsulated wall.

The work was done under the direction of Professors A. P. Kratz and M. K. Fahnestock and E. L. Broderick, all of the Illinois staff.

FIRE PROTECTION

According to a paper by R. C. Loughead, chief engineer of the Michigan Inspection Bureau, due to the inherent features of an air conditioning system it is impracticable to suggest specific fire protection that would properly apply to all cases and therefore it is necessary to give each system requiring protection special study and treatment. Most systems and especially ones which are confined to one floor or a part of a floor will usually not require any special fire protection if installed according to available regulations. However, larger systems supplying more than one floor may present a hazard which should be protected regardless of installation methods. The best assurance against loss by fire is not only a sound engineering installation but the maintenance of cleanliness in the system at all times and constant vigilance by the owner or occupant.

Equipment now being developed for the detection of smoke in air conditioning systems is intended to reduce the possibilities of smoke damage and panic hazard. These devices are intended to shut down fans, close dampers, sound alarms and perform other necessary functions to prevent the spread of fire and smoke.

Although developments in the air conditioning industry are advancing rapidly many of the necessary regulations which have been established are in a continual state of flux. The industry is cooperating in the development of suitable protection as it has recognized that acceptable safety features must be incorporated in the design of these systems to eliminate the possibility of serious catastrophes.

WATER HEATING

More than 200,000 coal and wood water heaters for domestic hot water supply are produced annually in this country and consequently methods for evaluating the performance of such equipment are of interest to those who design, select, install and operate such apparatus.

Methods were described in a paper by H. J. Rose and R. C. Johnson for testing domestic hot water solid fuel fired heaters for maximum and minimum output, flexibility of output or response to control, maximum attention intervals and efficiency.

Average hot water demands per family range from less than 50 gallons to more than 200 gallons per day depending upon the size of family, ages and personal habits of the members, number of hot water outlets and standard of living. However, even in the case of

families with low average consumption there are periods of peak demand and storage tanks of less than 40 gallon capacity seldom provide enough hot water at one time regardless of the type of heater or fuel used.

A combined draw-off and banking test was described in this paper which simulates household demands and gives a good idea of the effect or performance which can be expected in actual use. Field installations of water heaters based on knowledge gained by tests have proved so satisfactory in comparison with previous methods of water heating used in the same homes that these test methods are assumed to be of engineering interest.

The authors are industrial fellows under the Anthracite Fellowship, Mellon Institute of Industrial Research, Pittsburgh.

OZONE

Does ozone counteract body odors? How are occupants affected by varying concentrations? Does ozone oxidize body odors in the air? These problems were studied in a series of observations conducted in experimental rooms at Harvard School of Public Health, and reported by W. N. Witheridge and C. P. Yaglou.

Results indicated that ozone in concentrations of 0.015 p.p.m., that can barely be smelled by the occupants of a room, reduced the smell of body odor sufficiently to permit a reduction of at least 50% of the amount of outdoor air required for odor control. Higher concentrations were irritating to the mucous membrances of the upper respiratory tract, while lower concentrations had no effect on body odors. The action of ozone on body odors appears to take place not in the air of the room by oxidation, as is sometimes assumed, but on the mucous membranes of the nasal passages by masking. Although ozone in sufficient strength completely obliterated the smell of body odors, it proved difficult to counteract the two so that neither could be smelled by persons entering the room from outdoor air. Ozone had to be present in perceptible concentrations to do any good at all.

The main objection to the application of ozone to ventilation is shown to be lack of control. Until adequate means are devised for controlling the output of ozonators from the actual concentration in occupied spaces, the use of ozone should be discouraged because of its great toxicity.

Mr. Witheridge is industrial hygiene engineer of the Bureau of Industrial Hygiene, Detroit, while Mr. Yaglou is associate professor of industrial hygiene at the Harvard School of Public Health.

LOW COST HOMES

According to R. K. Thulman, mechanical engineer of FHA, and Prof. L. E. Seeley of Yale University, it is of vital importance to establish a common viewpoint in the heating of low-cost homes intended for occupancy by families with incomes of less than $2,000 a year.

The authors suggest that low-cost home developments should have as a minimum supply 30 to 50 gallons of hot water available per day. While this domestic hot water need not be supplied by the heating system there will be instances where the heating plant will supply this water and in these cases the performance of the combined equipment must be considered.

Climatic conditions vary in different sections of the country making differences in heating costs seem inevitable and it is estimated that the maximum capacity of a heating system may vary as much as 400% for a given structure. This range may be reduced by insulation, control of window sizes and generally better construction by about 100%.

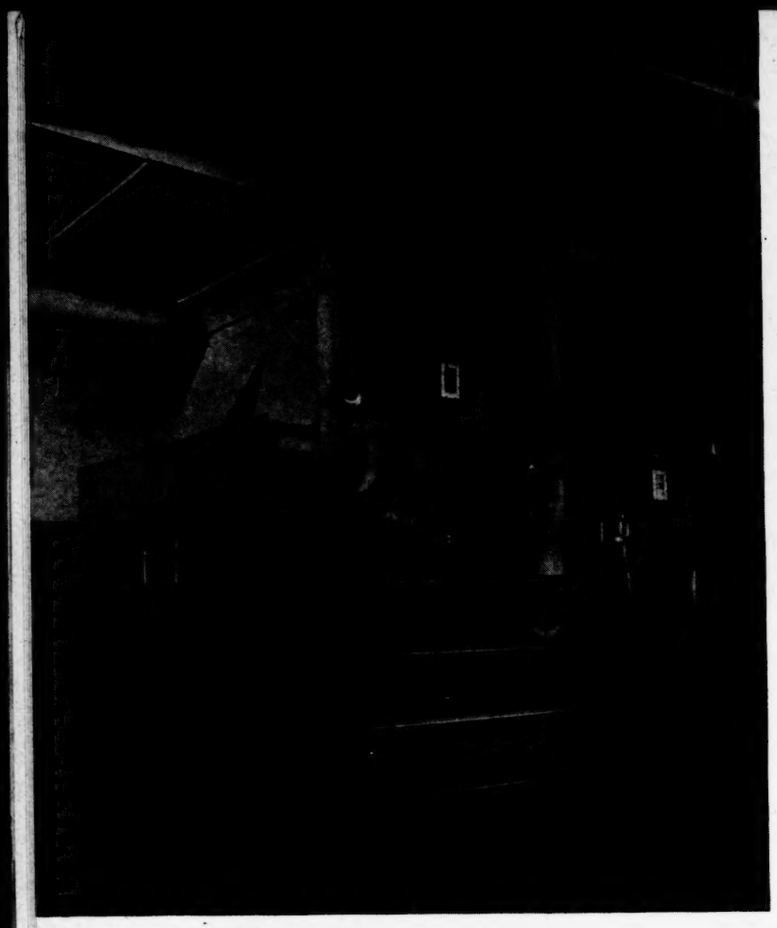
Low-cost homes should not be analyzed in terms of first or initial costs but in terms of operating and maintenance costs. Present trends are towards development of individual heating units which can be installed regardless of whether there is a basement and one feature of this design is that there is a tendency to confine equipment in a very small space.

According to the authors there is a definite trend toward the decrease of the design loss of the house by tighter construction, use of insulating materials, and more compact plans, which directly affects the maximum capacity of heating systems and particularly automatic firing devices. As a result of this trend, there is a lack of small capacity devices available. At the present time, this trend is resulting in an increase in the use of small gas-fired equipment where low capacities are not a serious problem. If a continuousness of heat output is to be obtained as preferred to highly intermittent heat, it would seem that the attention of the heating industry should be directed toward the development of devices with a capacity much smaller than those in present use.

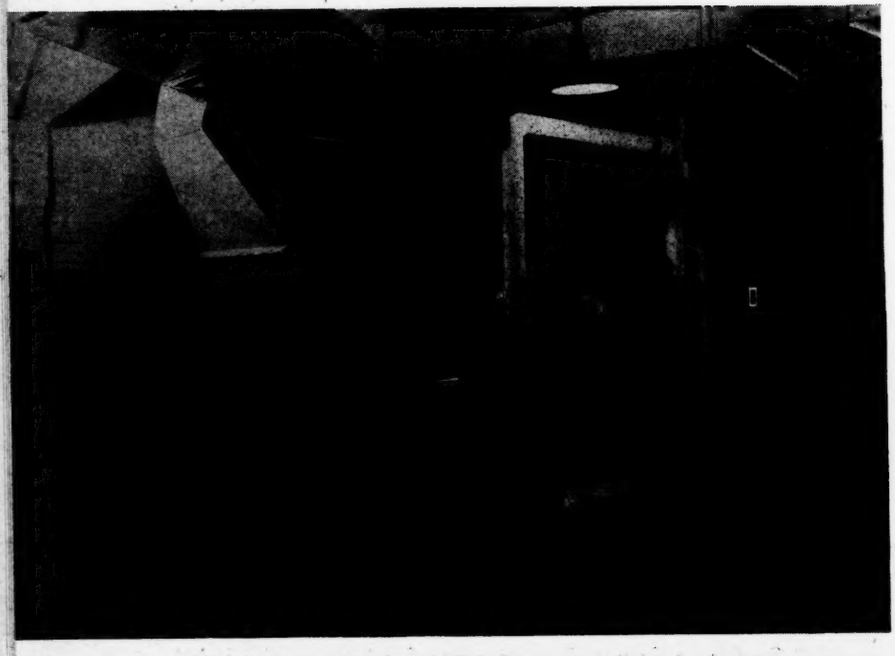
While there is a tendency toward the development of automatic devices, this does not mean that development of devices to burn solid fuel manually should not continue, because automatic control is necessarily associated with higher cost and is necessarily limited in its application to a relatively small percentage of the possible occupants of low-cost homes. The availability of wood, particularly in rural localities, suggests the desirability of developing wood-burning equipment which possesses definite qualities of convenience and economy. It is axiomatic that lower costs create a greater market.

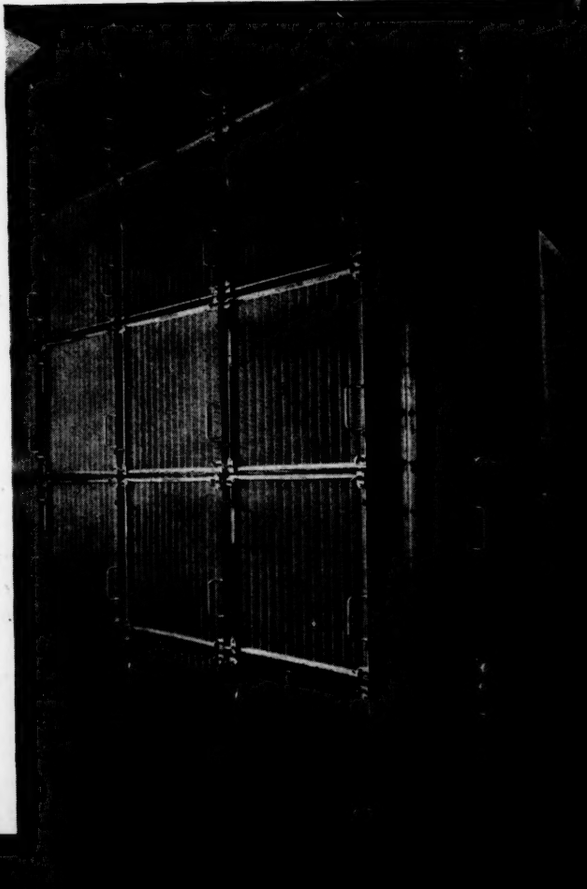
So far as future developments for heating the low-cost homes are concerned, there will probably be a continued improvement in all types of heating systems burning all types of fuels. These improvements will be made with the necessary considerations for reduced size, better performance, and greater operating economy. There is reason to believe that certain social considerations growing out of reduced space and the need for privacy may result in an increased use of the combination of a heating unit with a definite distribution system so that isolated rooms may be properly heated.

A reduction in heat losses without a corresponding reduction in hot water demand has developed the use of domestic hot water as the heating medium. Although not new, this development will probably continue.

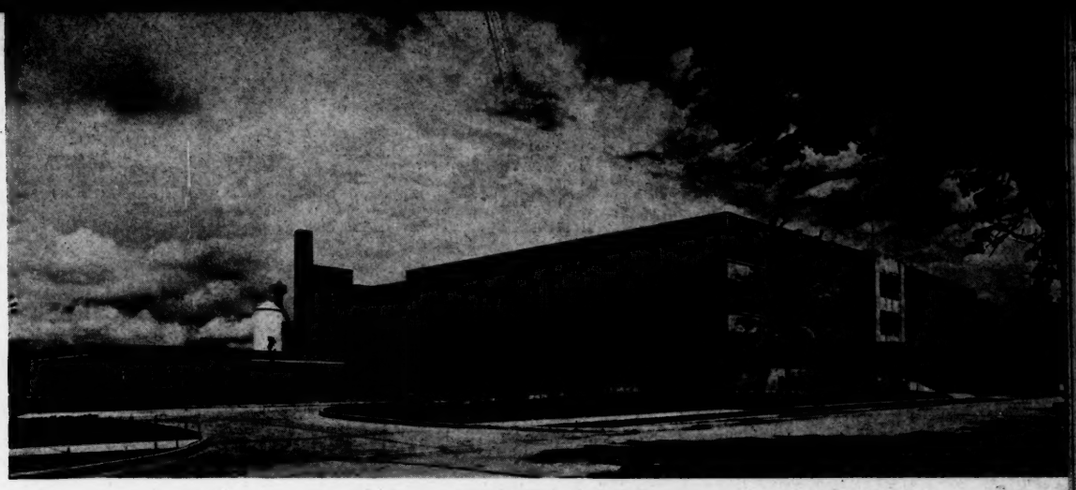


AIR CONDITIONING MILES LABORATORIES





(Above) Conditioning unit which supplies air to the manufacturing space in the front section of the second floor. All return and outside air is filtered as it enters the conditioning unit. (Upper Left) Comfort air conditioning unit which serves the lunch room on the third floor. Well water passing through closed coils is used for cooling. (Left) Air conditioning system which serves the shipping room. (Lower Left) Conditioning system which supplies air to the manufacturing space at rear of second floor. (Below) The comfort air conditioning system for offices. All photos used by courtesy of Clarage Fan Company.



New Plant for Alka-Seltzer Has Separate Systems for Comfort and Process

MILES Laboratories, Inc., maker of Alka-Seltzer, has just completed and is now occupying its fine, new plant at Elkhart, Indiana.

The new building, modern and fireproof in every respect, is 187 ft. wide and 352 ft. deep. The main office and factory portion is three stories in height. In addition, there is a one-story and basement warehouse, which is 105 ft. by 123 ft.

The new addition contains 3,000,000 cu. ft. and has a floor area exclusive of penthouses of 250,000 sq. ft. In the basement are located a 50-car garage, boiler room, factory, and warehouse. The first floor contains the general offices, 120 ft. by 187 ft., and the shipping, receiving, and warehouse sections. The second and third floors, each containing 51,250 sq. ft., are devoted exclusively to manufacturing, experimental laboratories, rest and toilet rooms.

The outside walls are face brick and glass block. Continuous strips of glass block 7 ft. in height carry around all floors, flooding the interior with natural light.

The health and comfort of the employes have been given primary consideration. The entire building is air conditioned, the cooling medium being water supplied by one 500-g.p.m. well and one 750-g.p.m. well, located on the company property. It is the intention to maintain a uniform degree of temperature and humidity throughout the entire year, regardless of outside weather conditions.

Two Systems Installed

The cooling and humidifying agents consist of two separate and distinct systems, one system for comfort and the other for process. The comfort system is handled entirely by well water in the summer time and by steam for heating and atomized hot water for humidifying in the winter time. The units for the comfort system were manufactured in accordance with specifications prepared by the company. The water from the wells is circulated through closed coils in the units, and is finally discharged on the roof areas, where an average depth of two to three inches is maintained during the cooling season. All roof areas are dead level, and connections made so that excess water will drain automatically to the sewer. The air from these air conditioning units is distributed throughout the building by means of wide, shallow ducts located tight against the ceilings and with small orifices spaced on close centers.

In the general offices, the air is expelled through a narrow continuous slot in the ductwork. This continuous slot is located on both sides of the duct, one side supplying the private offices and the other side taking care of the general office space. The unit supplying the general office has a capacity of 25,000 c.f.m. The units in the other branches of the building have a 10,000 and 15,000 c.f.m. capacity. The heating coils in these units are of the tube-within-a-tube type.

The process air conditioning is handled by mechanical refrigeration. The requirements are equal to the melting of 160 tons of ice in a 24-hr. period. All of this equipment was supplied in accordance with specifications prepared by the company. The control is completely automatic and under continuous recording. The company has found that the glass block construction has been a big aid in maintaining the proper conditions within the building, both in summer and in winter. They have not been confronted with wind leakage, nor are they troubled with condensation in the winter time. Venetian blinds were installed in the offices to control the amount of light and these have also assisted in the air conditioning process. The owners have found that the type of structure used lends itself admirably to air conditioning, and only one or two adjustments in the air conditioning system were necessary.

The total amount of air handled by both systems is 150,000 c.f.m.

Process steam and heat are supplied by two 150-hp. stoker-fired boilers located along the switch tracks. The coal is stored in a 400-ton concrete silo, and coal and ash removal are handled with the least possible effort.

The main entrance feature has been designed along modern lines. The revolving and side entrance doors and canopy are made of aluminum and the steps and walls of the entrance are of cut stone and granite. All office partitions are of steel and the ceilings are constructed to absorb sound.

The structural engineer in charge of the preparation of plans and the superintending of the building was Frank A. Randall, Chicago. The air conditioning systems were designed by W. E. Lowell, air conditioning engineer for Miles Laboratories, Inc.

The Basic Fuel Factor

By C. GEORGE SEGELER†

C. George Segeler

FOR many years the gas industry has kept accurate records of the relation between the estimated fuel consumption and the calculated heat loss of buildings. It is no news to announce a close check between prediction and actual results. In fact, the reputation of the industry would seriously suffer if any wide divergence between the estimated gas consumption and the actual bill existed.

The further correlation of gas estimates with degree days makes it possible to compare results in various parts of the country. As far back as 1926, data collected by a large number of gas utilities shows that in the territories of 5,000 degree days or more, 116.6 B.t.u. per sq. ft. of theoretical cast iron steam radiation[1] were required per degree day. This figure was obtained by averaging a very large number of results without attempting to subdivide them or segregate them.

In 1932, the author[2] announced the results of a survey of that period covering 700 private residences. In this survey gas consumptions classified by type of installation were reported. Gas-designed hot water boilers, on the average, required 97 B.t.u. per sq. ft. of theoretical cast iron *steam* radiation per degree day; gas-designed steam boilers, 107 B.t.u. per sq. ft. of theoretical cast iron steam radiation; converted hot water boilers, 109 B.t.u. per sq. ft. of theoretical cast iron steam radiation; and converted steam boilers, 121 B.t.u.

Fig. 1 illustrates the range of values from which these averages were derived. As is to be expected, the differences between individual installations is quite large due to many variables such as living habits, heat gain from people, lights, and fuel using appliances; other factors such as differences in methods of heat loss computation, solar radiation are probably of equal importance. In spite of these differences, the averages yielded a workable basis for estimating gas consumption which has been widely employed in the gas industry.

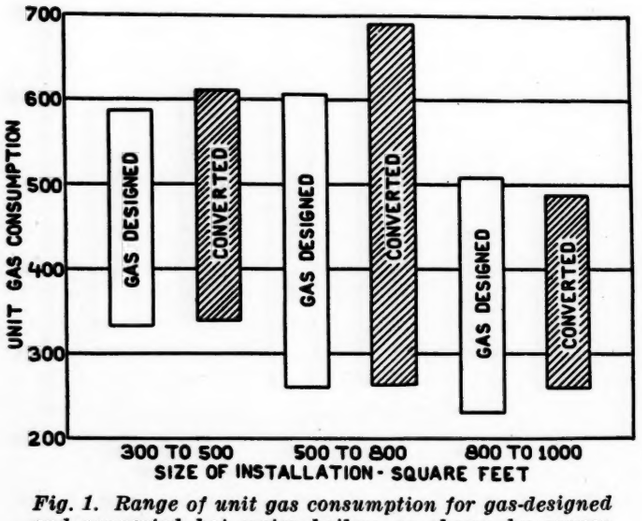


Fig. 1. Range of unit gas consumption for gas-designed and converted hot water boilers as shown by survey reported in 1932.

These average results indicated that there had been considerable improvement by 1932 in performance of gas equipment compared to results of 1926. It also showed that there was justification for considering each type of heating system on a separate basis to obtain reliable estimates of gas consumption. More recent work has reaffirmed this policy, and the American Gas Association book *Comfort Heating* (1938) includes recommendations to base heating estimates on the values shown in Table 1.

The figures of Table 1 can be readily converted to a basis of *Input B.t.u. per Degree Day per 1000 B.t.u. of Hourly Heat Loss at 0° and 70°* by simple calculation. When this is done the data of Table 1 take on the form indicated in Table 2.

These data are all based on field experience and permit the direct computation of gas required once the heat loss of a house is known or calculated. A *coefficient of performance* can readily be obtained from such figures, and this coefficient has been popularly called the *overall seasonal efficiency*. The values of this efficiency may exceed 100% by reason of such factors as heat gain, etc., just as described in a preceding paragraph. It should not be confused with thermal efficiency of the *boiler or heating system* which would naturally be at lower levels.

The so-called 100% overall seasonal efficiency gives the title to this article. It has been called *The Basic Fuel Factor* and has been described by Strock and

TABLE 1

GAS CONSUMPTION IN THERMS PER DEGREE DAY*
(BASED ON 0° OUTSIDE—70° INSIDE)

Hot Water Systems per sq. ft. of hot water radiation	Up to 500 sq. ft.	0.000708
	500—1200 sq. ft.	0.000675
	Over 1200 sq. ft.	0.000642
Steam Heating Systems per sq. ft. of steam radiation	Up to 300 sq. ft.	0.00121
	300 to 700 sq. ft.	0.00115
	Over 700 sq. ft.	0.00110
Warm Air Systems per 1000 B.t.u. hourly heat loss	Indirect or gravity systems	0.00428
	Fan systems	0.00409

*NOTES: (a) Data refer to gas-designed equipment. Conversion burners are assumed to be less efficient.
(b) Modification of data is necessary when design is on other temperatures.
(c) Data applies between 3000 and 6500 degree day levels. Below, add 10% to result; above, deduct 10%.

†Engineer of Utilization, American Gas Association.
[1]Theoretical cast iron radiation is the equivalent of 240 B.t.u. per hr. estimated heat loss.
[2]ASHVE Transactions, p. 543, 1932.

Hotchkiss in the various editions of their *Degree Day Handbook*[3].

They have continued to use the 1926 data and an overall seasonal efficiency of 82½% to obtain a Basic Fuel Factor of 96. 116.6 x 82½% = 96. If this value of 96 is used, then the efficiencies selected to obtain reliable fuel estimates must be *overall seasonal efficiencies* and not thermal efficiencies. The blocks in Fig. 1 show *overall seasonal efficiencies,* or performance coefficients, between 73½ and 91.6%, but the 1938 information used to set up Table 1 yields values for this coefficient between 79.3 and 97.8%.

Reynolds[4] states that records have been kept of this *seasonal efficiency* for practically all of the 4,000 gas-fired installations in his territory. They show results running as high as 125%. Such a figure shows an extreme variation of this term *seasonal operating efficiency* which, nevertheless, has considerable value for estimating fuel consumption if its limitations are understood.

In the light of the coefficients of performance reported in the 1932 and later surveys, the Basic Fuel Factor of 96 is apparently too high because the underlying data on which it was founded was too high as it derived from moderate size 1926 steam jobs for which the overall seasonal efficiency would not be 82½% (as was suspected by Strock and Hotchkiss) but 73%. As a matter of fact, the limited data reported by Ralph A. Sherman from a study in Columbus, Ohio, shown in Table 14 of the Degree Day Handbook, indicates a figure of 75% which, if applied to the original data, would have yielded a Basic Fuel Factor of 116.6 x 0.75, or 87.4.

The author believes that it should now be recognized that this figure of 96 for the factor is definitely too high and that a more nearly correct figure would be 84 B.t.u. per sq. ft. of theoretical cast iron steam radiation per degree day at 100% efficiency.

The author recommends also that computations using the fuel constant method (II) suggested by Strock and Hotchkiss be based on this basic fuel factor of 84 B.t.u. per sq. ft. of theoretical cast iron steam radiation per degree day in place of 96. The following large-scale examples, taken from 1939 field data, prove the validity of this suggested change in the basic fuel factor.

A survey of 600 steam heating installations (average size 342 sq. ft.) was made at the close of the 1939 heating season by Public Service Electric and Gas Company of New Jersey. These houses used a total of 11.5 x 10^{10} B.t.u. of gas. To check this actual metered result by the Strock and Hotchkiss method, proceed as follows:

600 Installations—averaging 342 sq. ft. of steam

5300 Degree Days

Efficiency from the Degree Day Handbook Table 14 = 75%

$$\frac{600 \times 342 \times 5300 \times 96}{0.75} = 13.9 \times 10^{10} \text{ B.t.u.}$$

This result is too high as is to be expected from the previous discussion. Recomputing with a revised basic fuel factor—

$$\frac{600 \times 342 \times 5300 \times 84}{0.75} = 12.2 \times 10^{10} \text{ B.t.u.}$$

One can not help but observe that the revised factor now recommended is very much closer to the actual data obtained in the field than the original figure proposed by Strock and Hotchkiss. It must also be appreciated that in the computation just completed the *efficiency* was assumed to be 75% which was reported by Ralph A. Sherman from a limited study in Columbus, Ohio.

Using the actual data collected in New Jersey showing 11.5 x 10^{10} B.t.u. for this group of 600 houses and a computation at 100% efficiency, which results in 9.14 x 10^{10} B.t.u., a better value for *seasonal efficiency* for gas steam heating installations can be obtained than that proposed by Sherman. Considering that Sherman only used fifteen houses (only two of which burned gas) compared to the 600 houses in the present survey, there would seem to be a real justification for revising the *seasonal efficiency* which he reported.

The new average seasonal efficiency for new steam jobs is 9.14/11.5 = 79.5% and shows that the values in Table 1 may be too high because they were based on average results including many older types of boilers and furnaces.

Eighty per cent efficiency is such a commonly used round figure for boiler performance that it would be wrong to proceed without referring again to the limited and special meaning of the term *seasonal efficiency.* It should be considered accidental that the data yields 80% as the *efficiency.* It should not be interpreted in terms of boiler performance as has already been pointed out.

Consumption data is available from 1047 winter air conditioning systems, hot water boilers, and gravity warm air furnaces, which were a part of the total of 1647 units installed in various parts of New Jersey during 1937. The relative position of the four principal

TABLE 2

INPUT B.t.u. REQUIRED PER DEGREE DAY PER 1000 B.t.u. OF HOURLY HEAT LOSS AT 0° AND 70°.* (AS COMPUTED FROM TABLE 49 OF "COMFORT HEATING," 1938.)

TYPE OF SYSTEM	SIZE OR CAPACITY RANGE OF INSTALLATION	B.t.u. REQUIRED PER DEGREE DAY
Hot Water Systems	Up to 500 sq. ft.	471
	500—1200 sq. ft.	450
	Over 1200 sq. ft.	428
Steam Heating Systems	Up to 300 sq. ft.	505
	300 to 700 sq. ft.	480
	Over 700 sq. ft.	459
Warm Air Systems	Indirect or gravity	428
	Fan-powered	409

*NOTES: (a) Data refer to gas-designed equipment. Conversion burners are assumed to be less efficient.
(b) Modification of data is necessary when design is on other temperatures.
(c) Data applies between 3000 and 6500 degree day levels. Below, add 10% to result; above, deduct 10%.

[3]Extended discussion in second revised and enlarged edition of 1937, pages 246 and 247.
[4]Private Memorandum, David Reynolds, Boston Consolidated Gas Company.

TABLE 3

INPUT B.t.u. REQUIRED PER DEGREE DAY PER 1000 B.t.u. OF HOURLY HEAT LOSS AT 0° AND 70°.* (AS INDICATED BY CONSUMPTION DATA FROM NEW JERSEY INSTALLATIONS FOR 1938-1939.)

TYPE OF SYSTEM	SIZE OR CAPACITY RANGE OF INSTALLATION	B.t.u. REQUIRED PER DEGREE DAY
Hot Water Systems	Up to 50,000 B.t.u. per hour	475
	50 to 100,000 B.t.u. per hour	440
	100 to 200,000 B.t.u. per hour	415
	Over 200,000 B.t.u. per hour	408
Steam Heating Systems	Up to 50,000 B.t.u. per hour	475
	50 to 100,000 B.t.u. per hour	450
	100 to 200,000 B.t.u. per hour	430
	Over 200,000 B.t.u. per hour	425
Gravity Warm Air Systems	Up to 50,000 B.t.u. per hour	475
	50 to 100,000 B.t.u. per hour	432
	100 to 200,000 B.t.u. per hour	395
	Over 200,000 B.t.u. per hour	391
Forced Warm Air Systems	Up to 50,000 B.t.u. per hour	475
	50 to 100,000 B.t.u. per hour	427
	100 to 200,000 B.t.u. per hour	383
	Over 200,000 B.t.u. per hour	378

*NOTES: (a) The values given in this table would have to be modified for territories of less than 3,000 degree days. Factors should be increased 10% for the warm climate and for cities of more than 6,500 degree days, it is possible to decrease the factors by the same amount.

(b) Modification of data would be necessary if applied to installations where design is on basis other than 0° and 70°.

heating systems determined from the 1938-1939 gas consumptions taking steam heating as unity, is as follows:

Steam	100% of estimated gas consumption
Hot Water	96% of consumption of steam system
Gravity Warm Air	92% of consumption of steam system
Winter Air Conditioning	89% of consumption of steam system

The data shows that some differentiation could be made on the basis of size of house, but this does not play an important part unless houses less than 65,000 B.t.u. hourly heat loss are being considered. Below this point, there is a decrease in the efficiency of all heating systems, and a rapid narrowing of the spread between them, until at 40,000 B.t.u. there is little difference between any except the winter air conditioning which retains a slight advantage.

Table 3 is based on the results of the 1647 installations in New Jersey for which gas consumption data for the winter 1938-1939 are available. All of these houses are designed for 0° outside, 70° inside with night set back to 60°. The heat loss estimates are on a uniform basis using *Comfort Heating* as a source of heat transfer coefficients.

Several examples may help to show how Table 3 can be applied.

Example I. What is the estimated gas consumption of a house having 95,000 B.t.u. heat loss after adjustment to a 0° and 70° basis, located in Butte, Montana, for a normal heating season using a gravity hot air system?

SOLUTION: Butte, in northern United States, has 8272 degree days. The size of the house brings it into the second classification. Therefore, 432 B.t.u.—10% = 389 B.t.u. are required per M B.t.u. heat loss per degree day. The gas consumption would be $389 \times 8272 \times 95 = 30.6 \times 10^7$ B.t.u.

Example II. No heat loss survey being available on a house located in Baltimore, it is necessary to use an approximation based on the sq. ft. of radiation. There is 300 sq. ft. of steam radiation installed. How much gas will be required when the heating value is 500 B.t.u.? There are 4533 degree days per heating season.

SOLUTION: 300 sq. ft. of steam is equal to 72 M B.t.u. on the assumption that the steam heating season is just about equal to the theoretical heat loss. The factor can, therefore, be selected from the second classification under Steam Heat. Table 1 shows 450 B.t.u. required per degree day using gas. Since there are 500 B.t.u. per cu. ft., this is approximately 450/500 cu. ft. of gas for each M B.t.u. hourly heat loss per degree day. The answer can readily be obtained by multiplying $72 \times 450/500 \times 4533 = 293{,}000$ cu. ft.

Dry Heat Storage

Increased interest is being shown in the commercial possibilities of dry heat storage in which small lumps of magnetite are contained in refractory tubes and heated by electricity. This method is being employed in the heating of buildings and for drying.

According to Gaston Roux, writing in Revue Generale de l'Electricite, the first industrial plant of this type was installed at the Chedde (Haute Savoie) works of the Cie. de Produits Chimiques et Electro-Metallurgiques Alais, Froges at Camargue, in 1936. This heater, directly connected to a 6,000 volt supply, absorbed 100 kw and stored approximately 4,000,000 B.Th.U. in 6 tons of broken magnetite, heated to between 900 and 1100 deg. F. Satisfactory results were obtained in the drying of potassium chlorates and other salts, and a second high-voltage heater was installed at Asnieres for heating offices and rooms for engineers of the Nord-Lumiere company. At Asnieres, about 4,158,000 B.Th.U. are stored during a charging period of 14 hours, and the stored heat is utilized over the twenty-four hours.

For use in small houses and flats, thermal storages operating on the same principle are made by compressing powdered magnetite in steel tubes lined with insulating material and surrounded by cast-iron blocks which contribute to the storage of heat.

Magnetite has been chosen as the best material for this form of heat storage after extensive trials with many minerals. It is found almost all over the world, and contains 80 per cent iron oxide, 10 per cent silica, 4 per cent each alumina and lime, and 2 per cent other oxides. Its specific gravity ranges from 4.2 to 5.2; hardness 5.5 to 6.5; melting point 2,370 to 2,640F and specific heat 0.18 to 0.22, according to temperature.

A Review of the American Standard Safety Code for Mechanical Refrigeration

The revised edition of the American Standard Safety Code for Mechanical Refrigeration which was recently adopted by the American Standards Association as an American Standard should be of interest to all engineers doing air conditioning work because it is expected that this code will serve as a model for the authorities of various municipalities throughout the nation who control the installation of air conditioning and refrigerating systems. In this article an attempt is made to point out some of the more important features of the new code. Anyone interested in obtaining a copy of the complete code can do so by writing the American Society of Refrigerating Engineers, 37 West 39th Street, New York. The price is 20 cents.

IN OCTOBER, 1934, just one year after the first American Standard Safety Code for Mechanical Refrigeration was adopted, a committee was appointed to consider revisions. From that date until the fall of 1938 the committee together with various authorities and committees of interested groups worked revising the code to make it include the new developments and to put it in a form so that it would be universally acceptable. It was then approved by the American Society of Refrigerating Engineers, its sponsor, and on April 20 of this year, was approved by the American Standards Association as an American Standard.

In this 1939 revision, refrigerating systems are divided into eight classes, five of which are shown in Fig. 1. The first, which is not shown in Fig. 1, is a unit system and is defined as one which has been assembled and tested prior to its installation and which is installed without connecting any refrigerant containing parts. The sixth which is called an indirect absorptive brine system is an indirect vented open spray system in which the brine will chemically absorb the refrigerant in the system, and the chemical compound so formed in the solution will be stable at temperatures up to 100F. The brine must be of such quantity and concentration that it will absorb twice the total quantity of refrigerant in the system and an approved automatic device must be provided for shutting down the system when the concentration becomes such that the brine will absorb only one and one-half times the total quantity of refrigerant in the system. The seventh system is termed a double refrigerant system and is a system in which a refrigerant is used in the secondary circuit instead of brine or water. For the purpose of this code, each circuit must be considered as a separate direct refrigerating system.

Refrigerants

Refrigerants are divided into three groups dependent upon the hazards which they present in an automatic mechanical refrigerating system. The grouping is shown in Table 1.

When any group 1 refrigerant, except CO_2, is used in institutional or public assembly occupancies and any portion of the system containing the refrigerant is in a room where there is an apparatus for producing an open flame, the refrigerant should be classed in group 2.

Location of Refrigerating System

The code strictly limits the locations in which refrigerating systems may be placed. For example, in all but industrial occupancies, no refrigerating system may be installed in or on any public stairways. In the institutional and public assembly occupancies this is extended to include also hallways, lobbies, entrances and exits. In residential and commercial occupancies, unit systems are allowed in public hallways, lobbies, entrances and exits only when they contain not more than four lb. of a refrigerant and free passage is not obstructed.

In order to permit a convenient reference to the safety requirements of the code the requirements are grouped according to the nature of the human occupance. The five classifications are institutional, public assembly, residential, commercial and industrial occupancies.

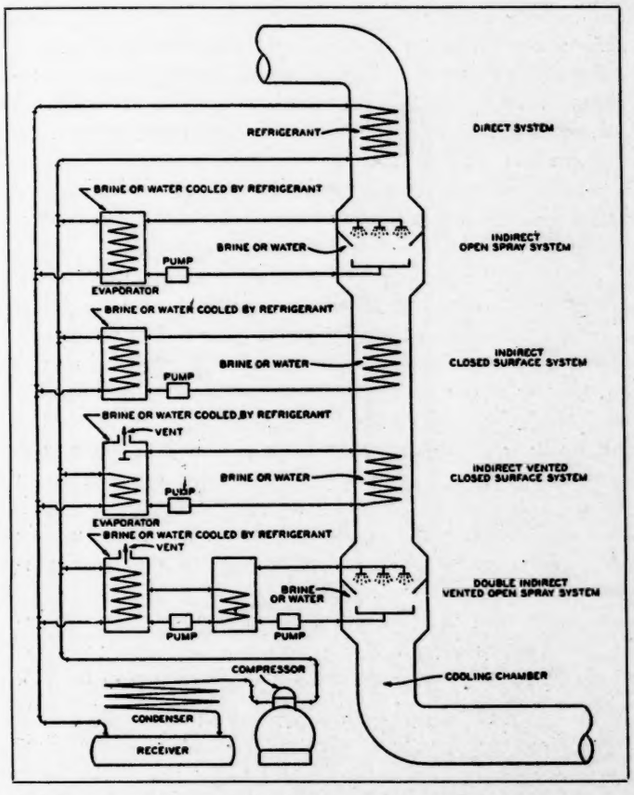


Fig. 1. Five of the eight types of refrigerating systems covered by the code.

Institutional Occupancy

The code defines institutional occupancy as that portion of a building in which persons are harbored to receive medical, charitable, educational, or other care or treatment. These premises are subject to stringent safety rules. Buildings falling in this classification include hospitals, asylums, police stations and court houses with cells.

Refrigerating systems installed in rooms other than special machinery rooms must be of the unit type and are limited to 10 lb. of group 1 refrigerants in all but kitchens, laboratories and mortuaries where unit systems containing 20 lb. of group 1 or 6 lb. of group 2 refrigerants may be used.

Systems containing more than 20 lb. of group 1 refrigerant must be of the indirect type with all refrigerant containing parts installed either outside of the building or in a machinery room used for no other purpose.

Systems containing not more than 500 lb. of group 2 refrigerants must be entirely within a special fire resisting, tight machinery room and when used for air conditioning for comfort must be of the indirect vented closed surface system, double indirect vented open spray system or an indirect absorptive brine type system.

No group 3 refrigerant is allowed in an institutional occupancy.

Public Assembly Occupancies

Public assembly occupancies which are subjected to slightly less rigid rules because the persons are relatively free to act in the case of emergencies are defined as that portion of the premises in which persons congregate for civic, political, educational, religious, social or recreational purposes. Department stores, theatres, and dance halls are included in this classification.

In these premises direct systems using group 1 refrigerants and containing not more than 1000 lb. of refrigerants are allowed provided they meet certain requirements. These are:

(1) Direct systems used for air conditioning for human comfort shall be limited to the volume of space to be air conditioned as shown in Table 2.

(2) If the refrigerating system contains more than 50 lb. of group 1 refrigerant other than CO_2 and has air ducts, it must be equipped with positive automatic fire dampers to cut off the refrigerant containing apparatus from the duct system. Also an automatic means must be provided to close the dampers and stop the fan when the temperature of the air in the duct at the damper location reaches 210F, when the damper is on the discharge side of a system containing a heating coil and at 125F, when the damper is on the suction side of the system or on the discharge side of a system containing no heating coil.

Systems not meeting these requirements or containing more than 1000 lb. of group 1 refrigerant must be of the indirect type. A system containing over 1000 lb. of group 1 refrigerant must have all its refrigerant containing parts outside the building or in a special machinery room used for no other purpose.

Group 2 refrigerants are limited to unit systems containing not more than 12 lb. of refrigerant and to other systems containing not more than 1000 lb. of refrigerant and having all refrigerant containing parts installed in a special fire resisting, tight machinery room. When systems containing a group 2 refrigerant are used for air conditioning for human comfort they must be an indirect vented closed surface system, double indirect vented open spray system, or an indirect absorptive brine system.

No group 3 refrigerants are allowed to be used in public assembly buildings.

TABLE 1. REFRIGERANT CLASSIFICATION

Group	Refrigerant	Formula
1	Carbon dioxide	CO_2
	Dichlorodifluoromethane (Freon-12)	CCl_2F_2
	Dichloromonofluoromethane (Freon-21)	$CHCl_2F$
	Dichlorotetrafluoroethane (Freon-114)	$C_2Cl_2F_4$
	Dichloromethane (Carrene No. 1) (Methylene chloride)	CH_2Cl_2
	Trichloromonofluoromethane (Freon-11) (Carrene No. 2)	CCl_3F
2	Ammonia	NH_3
	Dichloroethylene	$C_2H_2Cl_2$
	Ethyl chloride	C_2H_5Cl
	Methyl chloride	CH_3Cl
	Methyl formate	$HCOOCH_3$
	Sulphur dioxide	SO_2
3	Butane	C_4H_{10}
	Ethane	C_2H_6
	Isobutane	$(CH_3)_3CH$
	Propane	C_3H_8

Residential Occupancies

Residential occupancies are defined by the code as that portion of a building in which sleeping accommodations are provided for more than two families. Included in this classification are apartments, hotels, clubhouses and convents.

In these premises direct systems using group 1 refrigerant are permitted provided they meet certain requirements. These are:

(1) Direct systems used for air conditioning for human comfort shall be limited to the volume of space to be air conditioned as shown in Table 2.

(2) If the system contains more than 50 lb. of group 1 refrigerant, other than carbon dioxide, and has air ducts it must be equipped with positive automatic fire dampers to cut off the refrigerant containing apparatus from the duct system. Also an automatic means must be provided to close the dampers and stop the fan when the temperature of the air in the duct at the damper location reaches 210F, when the damper is on the discharge side of system containing a heating coil and at 125F, when the damper is on the suction side of the system or on the discharge side of a system containing no heating coil.

Systems not meeting these requirements or containing more than 1000 lb. of a group 1 refrigerant must be of the indirect type. A system containing over 1000 lb. of group 1 refrigerant must have all of its refrigerant containing parts outside the building or in a special machinery room used for no other purpose.

When group 2 refrigerants are used for air conditioning for comfort the system must be of the indirect vented closed surface, double indirect vented open spray, indirect absorptive brine or primary circuit of a

TABLE 2. MAXIMUM QUANTITY OF REFRIGERANT IN LBS. PER 1000 CU. FT. OF AIR CONDITIONED SPACE

Refrigerant	Formula	Quantity, Lbs.*
Carbon Dioxide	CO_2	12
Dichlorodifluoromethane Freon-12	CCl_2F_2	30
Dichloromethane Carrene No. 1	CH_2Cl_2	6
Dichloromonofluoromethane Freon-21	$CHCl_2F$	13
Dichlorotetrafluoroethane Freon-114	$C_2Cl_2F_4$	40
Trichloromonofluoromethane Freon-11	CCl_3F	35

* NOTES

a. When the refrigerant containing parts of a system are located in one or more enclosed spaces, the cubical contents of the smallest enclosed space other than the machinery room, shall be used to determine the permissible quantity of refrigerant in the system.

b. When the evaporator is located in a duct system, the cubical content of the smallest enclosed space served by the duct system shall be used to determine the permissible quantity of refrigerant in the system unless the air flow to any enclosed space in public assembly occupancies and in any room in other occupancies served by the duct system cannot be reduced below ¼ of its maximum, in which case the cubical contents of the entire space served by the duct system shall be used to determine the permissible quantity of refrigerant in the system.

double refrigerant type with all refrigerant containing parts either outside the building or in a special machinery room used for no other purpose.

Refrigerating systems are limited to 6 lb. of a group 2 refrigerant when installed in sleeping rooms or in spaces directly connected with sleeping rooms. Any system containing more than 300 lb. of group 2 refrigerant must have all refrigerant containing parts in a special fire-resisting, tight machinery room.

Group 3 refrigerants are limited to unit systems containing not more than 6 lb. of refrigerant.

Commercial Occupancies

Commercial occupancies are defined by the code as that portion of a building used for the transaction of business, for the rendering of professional services, for the supplying of food, drink or other bodily needs and comforts, for manufacturing purposes or for the performance of work or labor.

Where the manufacturing is done in an entire building by a single tenant, it is classified as an industrial occupancy and does not fall in this classification. Occupancies such as the following do fall in this classification: office buildings, restaurants, loft buildings and stores other than department stores.

In these premises, direct systems using a group 1 refrigerant and containing not more than 1000 lb. of refrigerant are permitted providing they meet certain requirements. These are:

(1) Direct systems containing more than 20 lb. of group 1 refrigerant when used for air conditioning for comfort shall be limited to the volume of space to be air conditioned as shown in Fig. 2.

(2) If the system contains more than 50 lb. of group 1 refrigerant, other than carbon dioxide, and has air ducts it must be equipped with positive automatic fire dampers to cut off the refrigerant containing apparatus from the duct system. Also an automatic means must be provided to close the dampers and stop the fan when the temperature of the air in the duct at the damper location reaches 210F, when the damper is on the discharge side of a system containing a heating coil and at 125F, when the damper is on the suction side of the system or on the discharge side of a system containing no heating coil.

Systems not meeting these requirements or containing more than 1000 lb. of group 1 refrigerant must be of the indirect type. A system containing over 1000 lb. of group 1 refrigerants must have all of its refrigerant containing parts outside the building or in a special machinery room used for no other purpose.

Systems which contain more than 20 lb. of group 2 refrigerants and when used for air conditioning for human comfort must be of the indirect vented closed surface, double indirect vented open spray, indirect absorptive brine, or the primary circuit of a double refrigerant type with all the refrigerant containing parts either outside the building or in a machinery room used for no other purpose. Any system containing more than 600 lb. of group 2 refrigerant shall have all refrigerant containing parts in a special, fire-resisting, tight machinery room.

The use of group 3 refrigerant is limited to unit systems containing not more than 6 lb. of refrigerant.

Industrial Occupancies

Industrial occupancies is used by the code to apply to an entire building when used by a single tenant for manufacturing, processing, or storage of materials or products. A single tenant is defined as a single authority which operates and maintains the entire building and refrigerating system. Buildings falling into this classification include chemical, food and candy factories, refineries and perishable food warehouses.

There are no restrictions on the quantity or kind of refrigerant used in these buildings except when the number of employees above the first floor exceeds one per 100 sq. ft. of floor area. Under these conditions the requirements of commercial occupancies shall apply unless that portion of building, together with its entrances and exits, be cut off from the rest of the building by vapor-tight construction with self-closing, tight-fitting doors.

Mixed Occupancy

Whenever a building is used for different purposes in different parts the more stringent requirements govern unless the occupancies are cut off from the rest of the building by tight partitions, floors and ceilings and are protected by self-closing doors. Under these conditions the requirements for each type of occupancy apply for its portion of the building.

Installation of Piping

With only a few exceptions no refrigerant piping is allowed to be carried through floors. Exceptions are:

(1) For connecting to a condenser on the roof, piping or tubing may be carried through a continuous, rigid and tight fire-resisting (four hour rating) flue or shaft having no openings on intermediate floors or may be carried on the outer wall of the building provided it is not located in an air shaft, closed court or in similar open spaces enclosed within the outer walls of the building.

(2) In occupancies other than institutional, refrigerant piping or tubing may be carried from the basement to the first floor and from the top floor to a penthouse on the roof.

(3) In occupancies other than institutional and public assembly when the refrigerating system contains a group 1 refrigerant, the refrigerant piping may be carried through floors provided it is enclosed in an approved, rigid and tight, continuous, fire-resisting flue or shaft where it passes through an intermediate space not served by the air conditioning system. Such a system when it is of the direct type and is used for air conditioning for human comfort shall have its quantity of refrigerant limited by the volume of space to be air conditioned as shown in Table 2.

(4) Industrial buildings have no restrictions as regards to carrying refrigerant piping through floors.

Other restrictions on piping in all buildings are:

(1) Refrigerating piping crossing an open space which affords passageway in any building must not be less than 7½ ft. above the floor unless against the ceiling of such space.

(2) Refrigerant piping must not be placed in public hallways, lobbies, stairways, elevators or dumbwaiter shafts, excepting that such refrigerant piping may pass across a public hallway if there be no joints in the section in the public hallway, and provided non-ferrous tubing of 1-in. nominal outside diameter and less be contained in a rigid metal pipe.

(3) Refrigerant piping, with or without insulation covering, must be exposed to view, excepting for mechanical protection herein specified, or when located in the cabinet of a Unit System. This does not apply to refrigerant piping installed outside the building or in a flue vented to the outer air.

Other Requirements

Other requirements covered by the code deal with installation, refrigerant piping, valves, fittings and related parts; design, construction, and safety devices; tests; and instructions.

Air Pollution and Disease

ALTHOUGH .... it is not as easy to trace air-borne ailments to their source, as it is water-borne diseases, I still believe that we are justified in holding polluted air at least partly responsible for the following ills:

1. The inhalation of smoke and gases causes an irritation to the mucous membrane of the nose, throat and lungs, thereby causing a congestion, which interferes with the normal protective secretion of the mucous membrane, and in that way makes the congested part very susceptible to infection.

We know that tuberculosis and pneumonia death rates are higher in the cities than in the rural areas, which should make all of us look upon city air with suspicion. The tendency has been to blame poor housing and crowded living conditions for a city's high respiratory death rates, when as a matter of fact living conditions in many rural homes are anything but sanitary and hygienic.

It appears to me that the important difference between urban and rural environment is not in the air within the houses, but rather in the air outside. When city residents, with more rest and recreation, better medical, hospital and public health facilities than are available to the rural population, suffer more from diseases related to respiratory irritation, than do rural people, it is time for us to ask: "What have the farmers got that we haven't got?"

2. Irritation from smoke laden air is not only responsible for respiratory infections, but also for one of our most common ailments, sinus infection. It is obvious that congestion produced by irritation in the nose and throat will not only lower the resistance against infection, but will also interfere mechanically with proper drainage of the orifices opening into the mouth, nose and throat.

Sufferers with chronic sinus infections are many times advised by their physicians to change climate; perhaps changing from a heavily polluted city air to clean, unadulterated country air would also bring some benefit.

3. We are learning more each day about allergy. We know that certain types of air pollution may sensitize the individual and produce allergic manifestations. I believe that I am safe in saying that asthma has a higher incidence rate in the cities than it has in rural areas.

4. A smoky atmosphere not only irritates the sensitive membranes of the eye, causing a conjunctivitis, but also interferes with proper daylight illumination, which may be responsible for eyestrain.

5. One of the greatest, if not the greatest health hazard of smoke, is its interference with the proper distribution of the available ultra-violet rays of the sun.

It is also unfortunate that during the fall and winter months, when the ultra-violet rays of the sun are at their lowest intensity, the smoke is at its greatest density. Vitamin D, which is produced by the action of the ultra-violet rays on the surface of the body, is essential to good health. When the heavy winter clothing and smoke prevent the weak violet rays from reaching our bodies, we will either have to obtain our Vitamin D in some other manner, or jeopardize our health. But the ultra-violet rays of the sun not only help raise our resistance against disease, but actually destroy disease by killing the infectious material in the air. It has been demonstrated by reliable authorities that contaminated rooms in hospitals and other places can be practically sterilized with ultra-violet ray lights.

If dangerous bacteria and viruses circulate in the air indoors, there is every reason for believing that such infectious material also finds its way into the outside air. When the ultra-violet rays of the sun are absent or at a low intensity, the infectious material in the outside air may remain virulent for some time. Perhaps it is for this reason that we have our regular epidemics of colds, influenza, scarlet fever and other contagious diseases during the months of the year when the ultra-violet rays of the sun are at a minimum.—*Abstracted from a paper by Dr. John P. Koehler, Commissioner of Health, Milwaukee, presented before the 1939 convention of the Smoke Prevention Association, held in Milwaukee in June.*

Split System of Heating and Ventilating for Michigan's Graduate School

The Horace Rackham School of Graduate Studies at the University of Michigan.

By JOHN J. WOOLFENDEN†

WHILE it is true that, broadly speaking, all heating and ventilating systems are developed from the same fundamental principles, it is also true that, in the design of a system of any size, there is usually a problem or two introduced by the use of the building, or its design, or by the other conditions or combinations of conditions that take it, at least in part, out of the classification of routine arithmetical computation and may even tax, to the utmost, the ingenuity of the designer to successfully solve.

It is also likely to be true that, after the solution is accomplished, the result may fit so easily into the scheme that there is no evidence of the labor and judgment necessary to effect it and it appears as the most natural thing in the world.

That it should be so, is one of the requirements of good design for, above all things, a properly designed installation should look as if it was meant to be just the way it is and (so to speak) as if, in the natural course of development, it shouldn't be any other way.

As some of the problems encountered in the design of the heating and ventilating system of the Rackham School may be of interest, in addition to a brief description of the building and of the heating and ventilating system, the description of a few such items is appended.

Availability of ample funds for construction permitted more careful planning at the Horace H. Rackham School of Graduate Studies at the University of Michigan, than is usually possible for buildings of this character. The purpose of the building and the uses to which it would be put were studied and a split system for heating and ventilating was chosen. The short period of warm weather ruled out mechanical cooling of the air. The diversified uses indicated that there should be a series of small separately operated equipments rather than one large central plant for the whole building. The large lecture hall received special treatment, with a form of panel heat along one wall.

Arrangement of Building

In its interior arrangement, the building consists of several stories devoted to various departments and uses, briefly as follows:—

A ground floor on which are work rooms, storage rooms, work shops, mechanical equipment rooms and a covered driveway which serves as a protected approach for use in connection with the social functions of the building and at other times for a parking space for the cars of the administrative staff. On the first floor are the administrative office of the Graduate School, the Rackham Trust Fund offices, work rooms for graduate students, the lobby and the main lecture hall seating some 1200 people.

The second floor has, at its center, a circular foyer around which, with connecting corridors, are arranged the men's and the women's reading rooms with their adjacent writing and music alcoves; the study hall with periodical alcoves at either end, and council, or committee, rooms for student group meetings.

Above this is a mezzanine floor, the central portion of which, between the trusses over the large lecture hall, is devoted to four large exhibition rooms, while on the east, south and west sides are the upper portions of the high rooms of the second story and work rooms for graduate students. On the north side are two meeting rooms.

The third story is set back on the east, west and north faces. In the south portion, in the center is the upper part of the study hall; in the central portion an amphitheater seating 250, with a fully equipped laboratory table, while on the east and west sides are meeting rooms

†Electrical and mechanical engineer, firm of Smith, Hinchman & Grylls, Inc., Detroit.

for the use of various groups or associations within the graduate school body and on the north, an assembly room with an alcove at either end, for use for receptions, dances and informal meetings.

Above this floor, in the space under the sloping roof, are located apparatus rooms for ventilating equipment, the elevator machine rooms and duct spaces.

A Split System

The heating and ventilation of the building is accomplished by means of a split system: the heating being by means of radiation sufficient to heat the occupied portions independently of the ventilation and the ventilation by means of tempered air supplied and removed by the various fan units since egress of air by the gravity system is not depended upon. An early discussion eliminated the use of refrigerated air, largely on account of the relatively short period of use of the building during the warm season. The steam supply is taken from the distribution system of the university power and heating plant. The heating system is of the two pipe vacuum type and the condensate is pumped back to the central plant.

As a result of the nature of the use of the building as well as of other considerations which will be later touched upon, a number of departures from routine design were adopted in both the mechanical and the electrical systems. It was obvious that certain rooms, such as the larger lecture hall, the amphitheater and the large assembly hall with its connected alcoves might have intermittent use—the latter, especially, in case of an evening social function, and also, that while the building must be continuously heated throughout, its ventilation requirements would necessarily be variable and the ventilating system must, therefore, be so designed as to give the requisite flexibility.

There must also be considered the amount of space required for both supply and exhaust ducts and apparatus, the location of the air inlets and outlets in the various rooms and the provisions to be made for these features in both the structural and the architectural design.

Series of Separate Systems

It was decided that the requisite conditions could be best met by the use of a number of relatively small supply and exhaust units advantageously located, rather than by the use of large units; except in the case of large areas, such as the main lecture hall, the amphitheater, etc., each of the units to serve groups of rooms requiring simultaneous ventilation.

This scheme offered in addition to flexibility of operation, the advantages of shorter duct runs, smaller ducts which, in turn, could properly be constructed of lighter gauge metal and a lower headroom requirement in the machinery rooms. Furthermore the weight of the units, individually, would be less although, since fan units, even including air washers, are not in the heavy machinery class, this was merely an incidental benefit.

The total capacity of the six supply fan units specified is 112,360 cu. ft. of 70F air per min. while the fourteen exhaust units specified are called upon to remove a total of 103,290 c.f.m. The difference between these totals can be explained by the desirability of subjecting certain areas to a slight pressure that leakage from doors and other openings might be exfiltration rather than infiltration.

The total required brake horsepower of these fan units, based upon design conditions, is 58.8. The drives except those of the very small units, which are of the utility set type, are of the V-belt variety. The aggregate rated motor horsepower is 91.

The fans are of the usual multi-blade type with forward curved blades. The motors for the main supply and main exhaust fans are of the variable speed (slip ring) type while those for the toilet exhaust and other similar units are of the constant speed type.

The blast coils consist of cast iron sectional stacks, of the usual pattern, and have a total heating surface of 8216 sq. ft., of which 5295 is in tempering coils and 2921 in retempering coils.

The supply units include both air filters and air washers, the latter acting both as an auxiliary in dust elimination and as a means of humidification control during the heating season, and of odor removal.

Were refrigerated air used for cooling, there would be a question as to the desirability of a fan operation at reduced speeds; however, with the air admitted to the rooms at normal design temperatures, the possibility of premature drop of the air admitted at lower velocities is eliminated.

The Ann Arbor City water supply, taken from wells, consequently had a considerable mineral content. Its hardness averaged well above 20°.

The matter of de-ironizing and of softening this water was considered but, owing to the fact that a municipal installation of equipment for that purpose was expected to be in operation within a short time, no apparatus for water treatment was installed.

However, on account of the effect of the water upon the sheet metal work, the air washers, excepting the easily replaceable scrubber and eliminator plates, together with all sheet metal work from the tempering coil casings to the fan inlets including the fan intake chambers, are constructed of sheet copper, due care being taken at all points of junction between the copper and the galvanized iron construction to prevent contact between the two metals.

Ventilation of Covered Driveway

The ventilation of the covered driveway, previously mentioned, is accomplished by admission, at its central portion, of the discharge from two of the larger exhaust fan units. In this connection, it must be remembered that the air handled by these fans while somewhat higher in CO_2 and lower in oxygen content than normal outside air, is taken from the breathing plane and is still breathable air although, were it not removed from the rooms, its continued presence would ultimately result in an unbreathable mixture.

However, this drive is approximately semi-circular and ramps down from grade some 7-ft. at each end. The ends are open and both openings face north. It is quite conceivable that a brisk north wind might exert an equal pressure through each of these openings and, if of a sufficiently high velocity, might materially reduce or even nullify the delivery of these fans by reason of the back pressure developed.

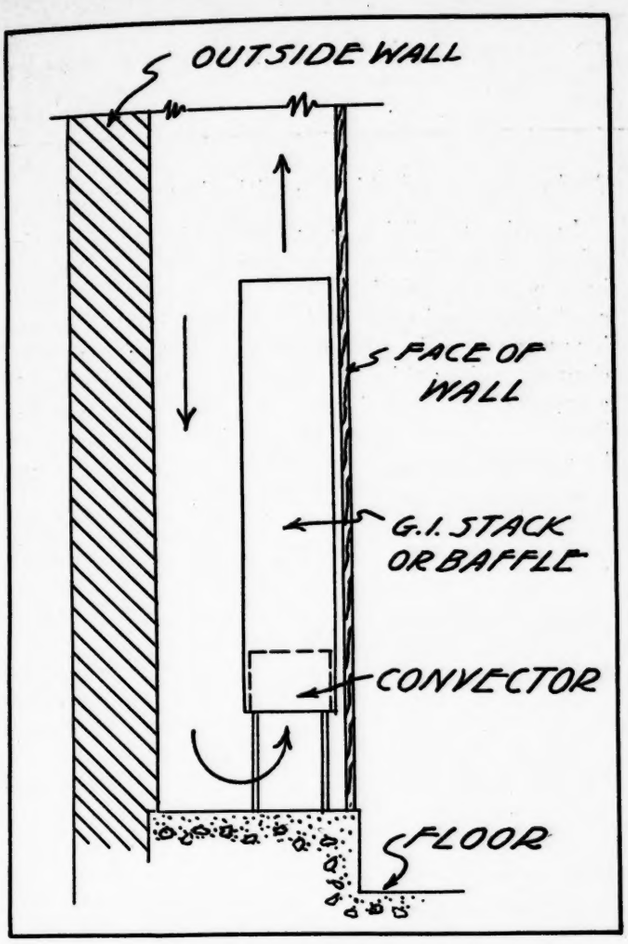


Fig. 1. Scheme of panel heating used in wall of Lecture Hall.

In order to eliminate this possibility, this driveway was vented by means of a tunnel running from its central portion through to the south side of the building thus offering a means of relief of any pressure which might be built up within the driveway.

Problems in the Large Lecture Room

The large lecture room is lighted by lights installed above the ceiling, the light being admitted through suitable small openings. The design calls for a total wattage of 60,000. In order to prevent an undesirable building up of temperature in the air in the above ceiling space, no glass was placed in the light openings, air being drawn through them into the space above.

Although, under certain conditions, it was thought desirable to ventilate the room below by use of the exhaust fans only, it was found impractical to do so, as their operation, without the balancing pressure due to the supply fans, reversed the circulation of air in the above-ceiling space and this reverse flow of air carried with it enough dust to make the light beams visible in the upper part of the room and produce a very undesirable and disturbing effect. It is evident that if one part of the ventilation system, only, is to be used at any time for circulating the air in this room, it should be the supply units.

Panel Arrangement for Lecture Hall Wall

The north side of this lecture hall is the north (outside) wall of the building. In order to offset the cooling effect of the large wall area and its effect upon those seated adjacent to it, it was desired to install the necessary amount of radiation along it. In a room of this character, exposed radiators would not be permissible nor, owing to the bowl shaped floor, and the presence of drapes hanging on the wall itself, did it appear feasible to install recessed radiation or convectors with the usual grilles and openings. The scheme finally used (*panel heating*) was to provide sufficient space between the wall itself and the plaster finish to install therein the required amount of radiating surface so that the heat loss through the wall is supplied by the radiation concealed in the deep furring space and not from the inside of the room, itself, and its effect upon the inside of the wall is, in consequence, nullified. The radiators are merely set in the space between columns and arranged with stacks (*or baffles*), as shown in the diagram, Fig. 1, so that the warm air rises along the inside wall surface and, as it cools, drops down on the outside surface of the space.

Neutralizing Window Heat Losses

In some of the larger rooms, the windows are high and extend down to the floor or nearly so. Drapes are hung at either side of the openings and it was decided to compensate for the heat loss by admitting air between the drapes and the glass, through the sides of the casings.

For this purpose convectors were used. Owing to the design and finish of these rooms, the conventional scheme of installation could not be used. Instead of being admitted by an opening directly below the radiators, the air is admitted from an opening several feet away near floor level, to the end of an intake box with short duct extension as required. The convector is set on top of this box, over a suitable opening. As its length is parallel to the wall, the end of the convector is adjacent to the side of the window casing in which the outlet grille is located. The discharge from the convector is, then, at an angle of 90° to its usual direction and the sweep of the discharge elbow is from end to end of the convector instead of from front to back. The outlet grille, itself, is some 9 inches in width by 30 or more inches in height and guide vanes were installed in the ells to insure a reasonably uniform distribution of heat from bottom to top of these grilles. The scheme of the assembly of these units is shown in Fig. 2.

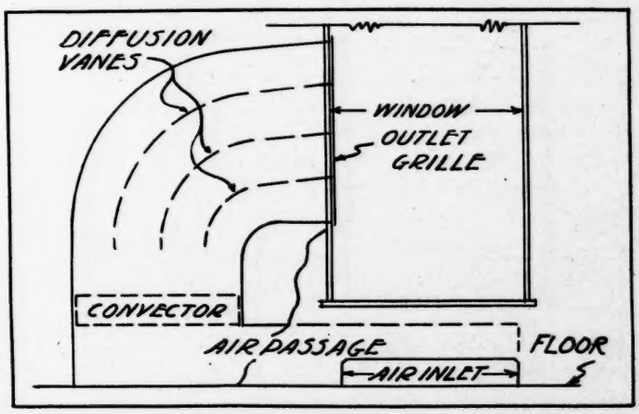


Fig. 2. Diagram showing convector outlet grilles in window jamb.

ABSTRACTS of Current Papers, Books and Pamphlets

Duct Exhaust Noise

Rushing sounds at the outlets of ducts have been a source of annoyance to occupants of air conditioned rooms. This condition has led to serious consideration of sound generation by flowing air, and attempts have been made to measure the loudness level of these sounds. Up to the time of the present investigation few reliable data have been available. In previous instances, sounds generated in the test duct have been considerably augmented and even masked by sounds generated at the blower and telephone through the duct, the combined sounds being picked up by the measuring apparatus.

In the investigation described here elaborate precautions were taken to reduce fan noise to a level unnoticeable in comparison with sounds generated by air flow in the test duct.

The accompanying curves summarize the test results for the several lengths of 3.85, 5.85, 7.8 and 9.85 in. diameter ducts. The experimental points are not shown, as the full lines represented by the empirically-determined expression summarize them well:

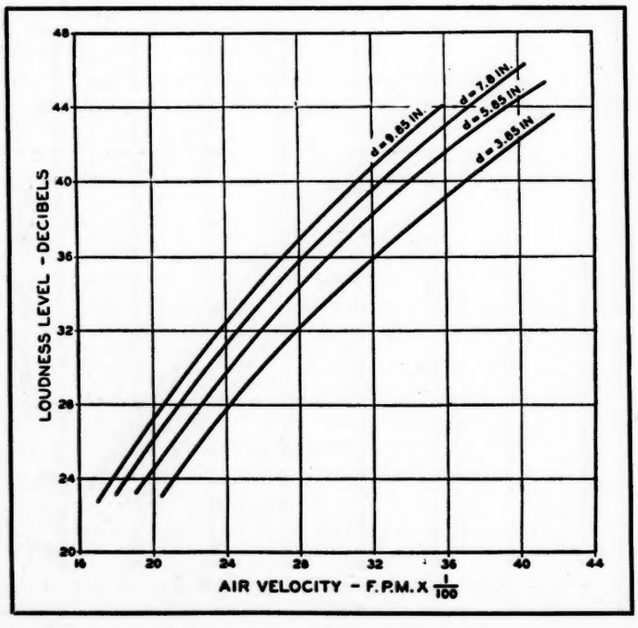
$$\text{Decibels} = 65.5 \log V + 12 \log d - 200.6$$

where V is the outlet velocity in f.p.m.

d is the duct diameter in in.

No sufficiently pronounced effect of duct length was present to warrant a term to account for the length of the duct. This suggests that the duct outlet is mainly responsible for sound generated by air flow through smooth straight pipe. The effect of duct size is that due to its perimeter, since db is a linear function of log d.

[*"Duct Exhaust Noise Depends on Velocity," by Walter W. Soroka. Published in Refrigerating Engineering, 41 W. 39th St., New York. June, 1939, page 393. Price, single copies, 50 cents.*]



Maintenance of Air Conditioning Systems

In order to efficiently operate and correctly maintain an air conditioning system, the operator first should have a sound basic knowledge of the principles of air conditioning and refrigeration. Second, he should know how to operate the system so as to secure the most efficient operation; third, he should be able to analyze in a systematic manner the operation of the system so that he can quickly locate troubles; and fourth, he should be well acquainted with mechanics so that he can correct the trouble.

This booklet meets the needs of the operator in regard to the three latter points in that it discusses briefly some of the factors involved in inspection, operation and maintenance of air conditioning equipment. The material which has been taken from a training course offered by the Associated School of Air Conditioning is divided into three main sections: Economical Operation of Equipment, Common Refrigerating System Complaints and Equipment Inspection, Operation and Maintenance. The latter section covers electrical motor operation and maintenance.

[*"A Guide Book for Efficient Operation and Maintenance of Air Conditioning Systems," by A. J. Rummel and L. O. Vogelsang. Published by Clemens-Knox, Inc., 124 E. Martin St., San Antonio, Texas. Paper cover; 6 x 9 in.; 30 pages; price, $1.*]

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Anthracite Coal Bins

For some time the Anthracite Fellowship at the Mellon Institute of Industrial Research has been developing and testing coal bins in an attempt to make available attractive dust-proof and efficient bins. Bins adaptable to almost every condition were included —flat bottom bins, built of plywood, for stoker equipment; hopper bottom, of tongue-and-groove lumber, also for stoker equipment; sloping bottom, with multiple recessed-bin-outlet, for hand-fired equipment; and sloping bottom, with masonry walls and earth fill, for hand firing.

The results of this work are presented in this bulletin, which, in addition to photographs and perspective, plan and vertical section drawings, gives a detailed tabulation covering the complete range of rated and reserve capacities, dimensions, material requirements and estimated labor necessary for each of the types.

[*"Modern Anthracite Bins." Bulletin No. M-3. Published by Anthracite Industries, Inc., 3207 Chrysler Building, New York. Paper cover, 8½ x 11 in.; 8 pages; copies available on request.*]

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How to Buy, Sell and Burn Coal

Persons concerned with fuel distribution or fuel utilization will find much of interest in this small book. The purpose of the book is to provide practical inform-

ation for users, sellers and burners of coal and it has been written by a man who has had all types of fuel burning equipment from small domestic units to control station equipment.

The book is divided into ten chapters which are entitled as follows: What the Purchaser Should Know About Coal; How to Select Coal; Fundamentals of Coal Burning Equipment; Sizing of Equipment; Schematic Analysis of Trouble; Boiler Tests; Smoke Abatement; General Combustion Information.

[*"How to Buy, Sell and Burn Coal," written and published by Thomas A. Marsh, 5625 Kenwood Ave., Chicago, Ill. Heavy paper cover; 5 x 6½ in.; 97 pages; price, $1.*]

BRIEF REVIEWS

Dust Counting. A report of tests conducted to determine whether certain types of dust counters shatter the dust particles. The authors conclude that both the Owens dust counter and the konimeter shatter quartz particles on impingement and this shattering gives rise to very misleading results both as to the number of dust particles actually present in the air and also as to the size distribution. The authors also state that there is little doubt that the Greenburg-Smith impinger will also shatter particles as the velocity of impingement in it is much higher than the average velocity in either the Owens counter or the konimeter. [*"The Shattering of Dust Particles by the Impinger," by D. G. Beadle. Published in the Journal of Industrial Hygiene and Toxicology, Vol. 21, No. 4, April, 1939, pages 109 to 120. Single copies available from the Williams & Wilkins Co., Mount Royal and Guilford Aves., Baltimore, Md. Price, 75 cents.*]

Leather Belting. Four rating tables for leather belting which have been brought out by the American Belting Association. The purpose of these tables is to furnish a reliable and economical basis for leather belt rating and make it possible for the designer and purchaser to set up his own specifications and to choose a belt. Table 1 lists horsepower transmission capacities for belts 1-in. in width at varying speeds with the same given large size pulley. The figures in this table do not represent peak load ratings but are based on proper tensions and factors of safety. Table 2 lists correction factors for various center distances and small pulley diameters. Table 3 lists various service correction factors due to atmospheric conditions, angle of center lines, pulley material, service and peak loads. Table 4 gives information on thickness specifications for flat leather belting. [*"Horsepower Ratings for Oak Tanned Flat Leather Belting." Published by the American Leather Belting Association, 100 Gold St., New York. Six pages; 8½ x 11 in.*]

Corrosion. A discussion of the value of short time tests of corrosion of metals in predicting the service life of such materials. Presents information and test data on "interim" and "accelerated" tests. [*"An Appraisal of Corrosion Testing as a Means of Predicting Service Life of Materials." Published by A. M. Byers Co., Pittsburgh, Pa. Paper cover; 8½ x 11 in.; 8 pages. Available on request.*]

Coal Analysis. A revised bulletin, giving methods used by the Bureau of Mines for analyzing coal and coke and determining their heating value and specific gravity, also methods for the determination of sulphur forms and carbon dioxide in coal, the agglomerating index of coal, and iron forms in coal-ash slags and clinkers, as well as for the analysis of coal and coke ashes. [*"Methods of Analyzing Coal and Coke," by F. M. Stanton, A. C. Fieldner and W. A. Selvig. Technical paper 8. Published by the Bureau of Mines. Paper cover; 59 pages; price, 15 cents; for sale by the Superintendent of Documents, Washington, D. C.*]

Corrosion. This bulletin on corrosion does not profess to be a complete treatise on the subject, but is merely a presentation of the author's views and experiments on certain phases of corrosion in which he has been especially interested recently. In order that the reader may not accept as final statements by the author on certain points, quotations from those holding different views are frequently given. From these conflicting opinions the reader may choose what appears to him to be the truth. [*"The Corrosion of Metals," by Oliver P. Watts. Engineering Experiment Station, Series No. 83, Bulletin of the University of Wisconsin, Madison, Wis. Paper cover; 6 x 9 in.; 32 pages; price, 25 cents.*]

Air Impurities. A description of a simple device for sampling air-borne bacteria. Device consists of a container with an inverted 60°, 3-in. glass funnel which sets over a standard Petri dish. Tests made with this device indicate that it has an optimum sampling rate of 1 c.f.m. Results are shown to be easily duplicated and bacterial concentrations can be expressed on a volume basis. [*"A Simple Device for Sampling Air-Borne Bacteria," by Alexander Hollaender and J. M. DallaValle. Published in the Public Health Reports, April 7, 1939, Vol. 54, No. 14, pages 574 to 577. For sale by the Superintendent of Documents, Washington, D. C. Price, 5 cents.*]

Blueprint Reading. Written primarily to acquaint welders with the reading of blueprints and drawings, although it contains much information of value to anyone concerned with mechanical construction. [*"Simple Blueprint Reading." Published by The Lincoln Electric Co., Cleveland, Ohio. Heavy paper cover; 8½ x 11 in.; 141 pages; price, 50 cents, postpaid in U.S.A.; 75 cents elsewhere.*]

Building Codes. A discussion of how building codes are drawn up and of the problems encountered. Useful sources of technical information are indicated and information is presented to help code committees proceed in their work with a minimum of lost motion. This is one of the reports of a series on building materials and structures being prepared by the National Bureau of Standards. [*"Building Materials and Structures, Report BMS19, Preparation and Revision of Building Codes," by George N. Thompson. Published by the National Bureau of Standards. Heavy paper cover; 8½ x 11 in.; 18 pages; price, 15 cents. For sale by the Superintendent of Documents, Washington, D. C.*]

EDITORIALS

A Factory Without Windows

When we eliminate window openings and depend entirely on air brought in from outside for all human and process purposes we are going beyond the usual responsibilities assumed when air conditioning is put into the traditionally constructed building. In such cases the air supply must not fail and neither must the exhaust, for any lengthy failure of either in a factory building especially would not only probably necessitate suspending operations but might endanger people as well. This general consideration is always an interesting one in connection with the several windowless buildings which have been built in recent years. In this issue we present the story of how the air supply and exhaust are planned for in the recently completed windowless factory building of the Simonds Saw and Steel Company at Fitchburg, Mass. This building, originally planned and started some years ago, has received probably more publicity in connection with its windowless feature than any other similar building in this country. What has not perhaps been as well known as might be is that the whole structure is one story in height, accommodates office and drafting space without partitions separating it from the machine operations, and that heat released from furnaces and ovens in the working space is prevented from reaching the general room air so far as possible. This one point is itself noteworthy. Why, we wonder, is it necessary to have a windowless building with a cooled air supply in order to get factory designers to put adequate insulation on the outside of hot ovens and furnaces and thus keep down the general temperature around these pieces of equipment. Yet, how often it is true that any worker for considerable distances around a hot industrial furnace or oven has to be overheated and have his ability to produce cut down by the failure to cut off the excess heat before it has a chance to get into the room air. It is expected that this conditioned, carefully-planned, windowless building will serve to teach many lessons, but if it could do no more than point to how readily stray and unwanted heat can be stopped in factory rooms it will serve a purpose useful beyond its benefits to the owner who had the courage to carry through such an innovation in factory planning.

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Air Conditioning on the Farm

Some months ago we published an article giving the results of tests showing the best atmospheric conditions for hatching chicken eggs. Shortly thereafter we were questioned by a reader as to why our engineer and contractor subscribers would be interested in this problem.

This was a fair question. Probably the only readers of ours at present directly concerned with this subject are those who are amateur chicken fanciers. We believe, though, that in the not too distant future our readers will be more and more concerned with numerous problems involving the maintenance of desired air conditions which do not fall within the traditional broad categories of air conditioning.

These traditional two groups of air conditioning have been for human comfort and for the furtherance or betterment of industrial processes. In recent years there have sprung up several air conditioning applications for the benefit of human beings but which are not necessarily for comfort, such as the fever cabinet for treating venereal diseases. To cover such applications perhaps a new classification, human welfare, is necessary.

Similarly there is going to be, we believe, increasing applications for processes not industrial. Among these may be a wide variety of applications concerned with agricultural processes. These will include the obvious ones of maintaining desirable air conditions to increase the efficiency of egg hatching and for the production of eggs themselves, the maintenance of conditions most conducive to maximum milk production by cows, and the maintenance of conditions best for the proper growth of hogs, and so on.

There seems to be no good reason why eggs should be hatched in small incubators and further there seems no good reason to suppose that large central air conditioning plants will not be used to maintain the desired air conditions in large buildings used for incubation. When such structures become an actuality then the air conditioning engineer must have information similar to that reported in the article referred to.

There seems little doubt that long before the industrial process market for air conditioning has reached the saturation point an entirely new and perhaps even broader market will have opened up on the farms.

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Cooperation Produces a Code

Highlights of the new safety code for mechanical refrigeration are presented in this issue. The new code differs sharply in detail from the older one in many important respects and covers much more ground especially in setting up requirements where refrigeration is used for air conditioning in various kinds of buildings. Appearing as an American Standard under the procedure of American Standards Association the new code can be expected to command respect and to be widely written into local codes and ordinances as time goes on. Perhaps the most notable feature of the new code however is that it represents the product of a co-operative effort of a committee formed to represent many viewpoints throughout the whole refrigeration and air conditioning field, following a virtual stalemate of some years' standing. It thus goes to show that we do have methods worked out whereby a reasonably definite working instrument can be devised in spite of a wide diversity of opinion as to what should and can be done to eliminate hazards from a field where the application methods are still in process of development. All this was accomplished without direct government intervention although pressure of public authorities for the development of a safety code was substantial.

NEWS OF THE MONTH

District Heating Group Holds Thirtieth Annual Meeting; New York Program and Fair Attract Attendance of 200

With the New York World's Fair only ten minutes away and with the most extensive exhibit of equipment in recent years, those who attended the 30th Annual Convention of the National District Heating Association at the Hotel Pennsylvania, New York, June 27, 28, 29 and 30, found something planned to take up every minute of available time. With so many attractions the Convention drew a total attendance of well over 200, all of whom assembled for the annual dinner party held at the Lido Country Club on Long Island on Thursday, June 29, even though the many attractions on the program resulted in the crowd splitting into small parties during the course of the Convention. In order to permit time for sightseeing at the Fair formal sessions of the Convention were fewer than in previous years and the program as arranged left afternoons and evenings open for New York and World's Fair trips.

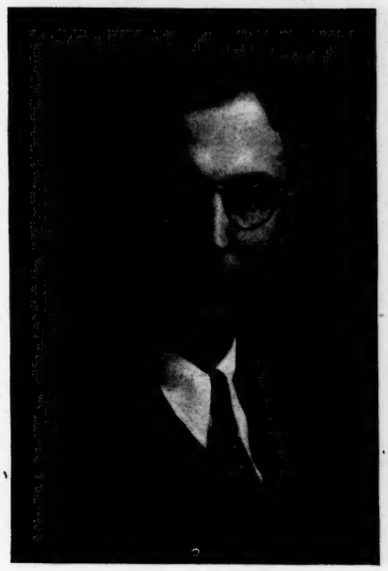
For the ladies, trips were arranged to Radio City Music Hall on Tuesday, with a motor tour of the city on Wednesday.

At the closing session on Friday morning, June 30, G. D. Winans, Detroit Edison Co., was elected president for the coming year. Other officers elected were F. L. Witsell, first vice-president; L. S. Phillips, second vice-president; and J. M. Arthur, third vice-president. W. H. Sanford was re-elected secretary-treasurer. Members of the Executive Committee for the coming year are J. R. McCausland, D. C. Turnbull, and R. M. Nee.

One of the events of the greatest interest on the whole program was the awarding of an honorary membership to William J. Baldwin, Jr., past president of the Association and who for many years has been connected with New York Steam Corp. George H. Martin, United States Realty Corp., New York, long an associate of Mr. Baldwin's, made the award of the honorary membership certificate during the dinner meeting on Thursday evening.

Following the usual plan under which this Association carries on its business the five sessions of the Convention were devoted to the reports of committees.

At the first session where President J. R. McCausland presided, an address of welcome was delivered by David C. Johnson, president, New York Steam Corp., while reports were presented by the Education, Membership and Operating Statistics Committees under the chairmanship of Landis Shaw Smith, Joseph M. Barnes, and A. D. Leach, respectively. H. H. Nickell reported for the Insurance Rates Committee, Secretary-Treasurer Sanford gave his annual report while A. R. Mumford and L. S. Phillips of New York, reported concerning the exhibits and convention arrangements.



G. D. Winans, newly elected President of the National District Heating Association.

The second session held on Tuesday afternoon with G. D. Winans presiding, was devoted entirely to a program arranged by Robert D. Martin of the Sales Development Committee. Speakers included F. L. Carlisle, chairman of the board, Consolidated Edison Co., New York; H. B. Bryans, executive vice-president, Philadelphia Electric Co., Philadelphia; Alex. Dow, president, Detroit Edison Company, Detroit; and Clara H. Zillessen, advertising manager, Philadelphia Electric Co., Philadelphia.

At the Wednesday morning session reports were presented by the Commercial Relations Committee under the chairmanship of John F. Collins, Jr.; the Rates and Regulations Committee, under the chairmanship of J. H. Walker, and the Research Committee, under the chairmanship of G. K. Saurwein. The Chemistry Committee, held a closed session, arranged by Louis Shnidman, chairman. Those who contributed papers for the reports of these several committees include J. C. Butler, Earle Shultz, R. M. Nee, V. B. Ingram, George H. Tuttle, Norman H. Davidson, R. M. McQuitty, H. W. Dierman, A. A. Markson, and A. S. Griswold.

In the report of the Commercial Relations Committee it was indicated that material is being collected for a Utilization Engineer's Manual, intended to make easier service work on customers' equipment on the part of utilization engineers and service men employed by the utility companies. Parts of this data were included in the Committee's report along with an outline of the ground to be covered by the proposed Manual. The same Committee is also gathering data looking toward the preparation of a small booklet to be distributed to customers to help them to understand their heating installation and how it works.

At the Thursday morning session with J. M. Arthur presiding, reports were presented by the Steam Station Engineering Committee, with R. G. Felger chairman, and the Distribution Committee under the chairmanship of A. A. Sellke. Included in those whose papers made up the reports of these committees were E. P. Durfee, W. H. Dargan, A. A. Markson, R. G. Felger, R. H. Brown, A. S. Griswold, A. R. Mumford, C. G. Hamel, R. H. McCumber, J. M. Barnes, A. C. McLellan, R. C. Hine, C. F. Donohoe, V. J. Suche, A. A. Sellke, W. A. Herr, A. L. Dutton, and H. G. Hill.

Following the report of the Meters and Accessories Committee under W. C. Wagner, chairman, the closing session on Friday morning heard a report by J. Earl Seiter summarizing the activities of the Advisory Council which has continued its program looking toward the development of promotional material to advance the interests of the whole district heating industry. Important in the plans is a suggestion that a periodical house organ be made available to carry the story of district heating to the public generally.

Included among the firms exhibiting in connection with the convention were American Blower Co., American District Steam Co., Au-Temp-Co., Inc., E. G. Badger & Sons Co., Bailey Meter Co., Builders Iron Foundry, Central Station Steam Co., Chapman Valve Co., Coe Manufacturing Co., Inc., Combustion Engineering Co., Davis Engineering Co., Dole Valve Co., C. A. Dunham Co., Ehret Magnesia Manufacturing Co., Foster Engineering Co., Heating & Ventilating, Johns-Manville Co., Johnson Service Co., M. W. Kellogg Pipe Co., Kieley-Mueller, Inc., Leeds and Northrup Co., Leslie Co., Marsh Tritrol Co., Midwest Piping Co., Milwaukee Valve Co., National Tube Co. (U. S. Steel Subsidiary), F. I. Raymond & Co., Sarco Company, Inc., Spence Engineering Co., U. S. Mineral Wool Co., Warren Webster Co., Webster Tallmadge Co., and Yarnall-Waring Co.

Standards Association to Set Toxic Gas and Dust Standards; Standards for Four Gases Considered by Committee

NEW YORK—The American Standards Association Committee on Allowable Concentrations of Toxic Dusts and Gases met June 30 to consider ways of controlling the amount of dangerous dusts and gases in the air as a protection to the health of workers, and sent to letter ballot of its membership four newly drafted standards outlining allowable concentrations of carbon monoxide, benzene, hydrogen sulfide, and carbon disulfide. Carbon monoxide has long been recognized as an extremely hazardous by-product of many operations and processes connected with everyday life, particularly dangerous because it is difficult to recognize and every human being may be exposed to it for varying periods at some time or other. All the other substances are of great importance to industry and are widely used in a variety of industrial processes.

Approval of these four standards by the committee and by the standards council of ASA will for the first time make available nationally approved and generally accepted standards defining the allowable limits to toxic dusts and gases.

In each case these standards identify the substance covered, and define the concentration permitted in the air during a specified number of hours exposure. As a means of checking the accuracy of the analysis on which the application of the standards is based, instructions are included as to where samples of air are to be taken, and how the analysis shall be made.

It is expected that industrial and engineering workers faced with the problem of controlling harmful dusts and gases may not have readily at hand the necessary data for the most effective use of these standards. For this reason all of the new standards include sections in the nature of appendices carrying their instructions into the field of medical knowledge by giving detailed information showing how these harmful materials affect human beings.

The draft standard on carbon monoxide, for instance, states the permissible range of concentrations in the air of work places beyond which presence of the gas becomes a health hazard to the normal individual. The medical information in this draft, as distinct from the engineering information usually included in American Standards, tells how carbon monoxide acts on human beings, how it is absorbed, how those overcome by the effects of the gas can be treated, and gives in some detail the symptoms of acute carbon monoxide poisoning, in mild, severe, and very severe forms. It is expected that this information will help those responsible for protecting the health of workers to recognize the conditions to which this standard applies. A chart shows the relation between exposure to carbon monoxide at various concentrations and the carbon monoxide symptoms which may be expected following exposure for several different time intervals. It is explained, however, that conditions inducing active breathing, such as heat, hard work, or carbon dioxide in the air, would affect the relationships between exposure and the resulting symptoms outlined in the chart. The other three drafts include the same type of information for benzene, hydrogen sulfide, and carbon disulfide.

The ASA committee at its June 30 meeting discussed the possibility of developing standards for silica dusts, for lead in all forms, and for hydrocarbons, as well as taking action on the four new draft standards.

The problems which the committee must face in developing standards in this field are many. It must review the work already carried out by experts in the field and by trade or governmental groups interested in problems of industrial health. Then it must arrange for whatever additional research is necessary in order to set up specific standards for the minimum quantities of toxic materials in the air which will produce recognizable physiological effects.

These standards when completed will be used by ASA committees working on methods of preventing occupational diseases, particularly by committees on the design and operation of exhaust systems. They will furnish information as to what constitutes injurious exposure, for the use of industry. They will also help insurance companies to advise their policyholders as to what control is needed to adequately protect their workers from disease hazards.

Radiant Heat for West Coast School

PORTLAND, ORE.—Interest continues in the subject of panel heating in the Pacific Northwest, where it has been recently introduced. Irwin L. Weber, Seattle heating engineer, was the principal speaker at a recent monthly meeting of the Oregon Chapter of the American Institute of Architects, held here. Mr. Weber designed the first radiant heat installation in the Pacific Northwest. The system is in the new high school at Everett, Wash.

The speaker outlined this installation, and pointed out that costs are about the same as for hot water radiator heat. His system, as exemplified at the Everett school-house, consists of hot water coils embedded in walls and ceiling surfaces of the area to be heated.

Big District Heat Plant in Merger

SPOKANE—One of the largest heating transactions ever made here was the transfer of a million dollar heating plant. J. E. E. Royer and Lewis A. Lewis, as trustees acting for the board of directors, conveyed the richly equipped plant of the Spokane Central Heating Co. to the Washington Water Power Co., the actual owner of the property as the parent company.

The transfer was in keeping with the plan outlined to the city council several months ago, when the new franchise issued to the heating company for the use of the power company was first considered. Transfer of the vast heating plant carries with it to the power company, for its own use, the heating company franchise passed by the city council April 25.

Egyptians Send Representative to Study Air Conditioning

LA CROSSE, WIS.—Striking a note of international amity in these troubled times are the foreign students who visit America to study American industries and institutions. At the express request of the Royal Egyptian Government and with the permission of the State and Navy Departments, Mr. Hussein Zaki, Egyptian student at Purdue University, will spend the summer becoming familiar with modern practices in heating, cooling and air conditioning at The Trane Company factory. Mr. Zaki was sent to America by the Egyptian Government to study American methods in those fields. He is a designing engineer for the Building Department of the Egyptian Government.

Sun Helps Reduce Hot Water Bill

HOOKSET, N. H.—Calling upon Old Sol himself to help keep down expenses, the owners of the Farm Kitchen, a resort on U. S. Route 3 in this town have built themselves a solar heater. Water to be heated for dish washing and other purposes is piped through a glass-topped box set up behind the restaurant. It resembles in appearance a gardener's hotbed. Several lengths of pipe are zig-zagged through the box and small metal flanges are soldered to the sides of the pipe, to aid in catching the heat from the sun's rays, which shine down through the glass top of the box. The pipes are painted black to assist heat absorption. Beside the solar heater is a large storage tank for the heated water.

The proprietors, Lee and Mabel Manzer, find that water which normally enters their heater at 48 degrees F, is raised to between 90 and 100 degrees by the time it enters the storage tank. There is an automatic water heater used as a booster, but its operating time is considerably reduced.

Paramecia in Projector Pirouette when Cooled by Conditioner

NEW YORK—There is no happier community at the World's Fair than the tiny troupers of the microvivarium in the Westinghouse building, but for the first three weeks of the big show they were as glum as professional mourners. And with reason. For the mortality among the pleasant paramecia, the wriggly vinegar eels and even the doughty daphnes was terrific.

Dr. Georg Roemmert, in charge of the exhibit, was upset. Normally, his pets were able to go through 75 to 100 performances daily and still be in fine condition when they were splashed back into their home jar in the backstage laboratory at night. But they began succumbing so quickly the technicians had to change the slides twenty times a day.

Dr. Roemmert learned ultimately that when the outside temperature was moderate—not much above 70F—the little one-celled acrobats did their stuff pretty healthily. But when it got to 78 or 80F outside, they began to grow figuratively weak in the knees.

It was calculated that when it was 70F outside, the arc lamps used in the projection machine brought the actual heat focussing on the slides to 80F or 85F; and that it was under such conditions that the sturdiest Dileptus anser or Anguila aceti gave up the ghost. At lower temperatures a heat filter in the machines was efficient enough to stave off danger.

The problem defined, the solution was next. Dr. Roemmert knew that an ultra-modern air-conditioning unit kept the visitors to the exhibit comfortable. But it did not cover the overlooking balcony that serves a multiple stage for the cast of thousands.

So Dr. Roemmert mentioned this to the exhibition's sponsors, and the result was extension of the ducts from the original air-conditioning unit so that every single Stentor coeruleus in the show could be as happy as any rubbernecker from Dayton or Dubuque.

At the next performance the vinegar eels—barely visible on their slide without magnification—put on the act that has earned them the title of the original jitterbugs. And a dozen or so daphnes proudly scooted around, while one of them, with the magnification stepped up from 300 to about 1,000 modestly displayed a heart beating 200 times a minute.

"If I put in a drop of alcohol," the doctor said, "the rate will go up to about 250."

Building Code Pending in N. J.

TRENTON—Numerous bills of direct and indirect concern to New Jersey's heating, ventilating and related industries are still before the New Jersey Legislature, which will reconvene here August 3, after a brief recess, for a drive to conclude its regular 1939 business.

Pending legislation includes a bill to create a legislative commission to prepare a model municipal building code. Another measure provides for state licensing of plumbers, while a licensing bill for painters and decorators also awaits action. Also pending is a bill to broaden the powers of the secretary of the State Board of Professional Engineers and Land Surveyors.

Several measures affecting the merchandising and delivery of home appliances and equipment are still pending. One of these would repeal a 1938 act, banning below cost sale of any merchandise by retailers or wholesalers. Another proposed bill would enable any municipality to impose license fees on businesses of other municipalities making deliveries within its borders.

Sun Heaters Popular in Miami

MIAMI, FLA.—The rays of the sun are being harnessed to provide an abundance of hot water for homes, apartments and hotels in Miami. Solar water heater units costing about $125 are usually placed on the roof of the house where they look like a skylight with a chimney alonside—the water tank being camouflaged like a chimney.

Under the method used, water is heated in copper coils placed in a copper pan with a glass cover over the pan. The sun's rays passing through the glass cover build up a blanket of hot air around the coils. As the water in the coils warms up it rises through a pipe into the insulated storage tank. One family houses usually have an 82-gallon tank, sufficient to hold enough water for four baths, the dishwashing and other chores. The water stays hot in the insulated tank for 72 hours of cloudy weather.

Some hotels and large apartments, use banks of the heater units in connection with a single tank, together with an electric booster to insure a continuous supply of hot water.

Kunz Heads Smoke Preventors

MILWAUKEE—R. W. Kunz, chief smoke inspector of Milwaukee, was elected president of the Smoke Prevention Association at its annual convention held here recently. Other officers are: first vice president, G. G. Richie, fuel service engineer of the C & O Railway; second vice president, John Benschip, smoke inspector, Pennsylvania Railroad; secretary-treasurer, F. A. Chambers, chief smoke inspector of Chicago.

St. Louis was chosen as the convention city for June, 1940.

A.C. Boosts Church Attendance

ESTILL, S. C.—Church attendance in this tiny town has taken a sudden jump as the result of a successful move by local pastors to hold church services in the new air conditioned theatre on "Main Street."

Churchmen in this vicinity were quick to take advantage of the opportunity offered by the installation of a Carrier air conditioning system in the new 304 seat theatre, particularly since Estill is reputedly the smallest town in the United States that boasts an air conditioned movie house.

Charles Harper, manager of the theatre, immediately agreed to offer the cool auditorium to help the pastors bolster church attendance, which falls off alarmingly during the hot Summer months. Joint services were organized and publicized in church bulletins throughout the community.

The result was pleasing not only to the church goers, but also to the theatre manager, Harper. His gesture brought people into the theatre, familiarized them with the comfortable surroundings and sent attendance soaring for his week-day shows.

Direct Water Heaters Legalized

SPRINGFIELD, MASS.—Coal dealers here regained a market which has been closed to them for the past eight years, when the City Council and Board of Alderman adopted the revised building code authorizing installation of direct hot water heaters. The new code was immediately signed to become law by Mayor Roger L. Putnam.

Passage of the new code marks the end of a five years' struggle on the part of coal dealers, the last three of which they have been aided by Anthracite Industries, Inc., whose engineers and staff members furnished the building code committee with data regarding anthracite.

After the law was signed Robert E. Cosgrove, secretary of the Fuel Credit Exchange, announced plans for a "Victory Dinner" at which it is expected formation of a cooperative sales campaign will be inaugurated.

Chicago Adds 688 Tons of A.C.

CHICAGO—Two hundred and ninety air conditioning installations totaling 688 tons were connected to the lines of the Commonwealth Edison Company during June according to reports from that utility. Of these 235 of the installations were room coolers. The largest single installation during the month was an addition to the Chicago Rotoprint plant totaling 75 tons.

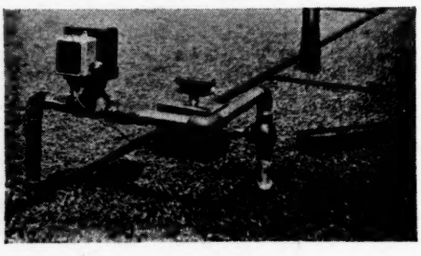
NEW EQUIPMENT

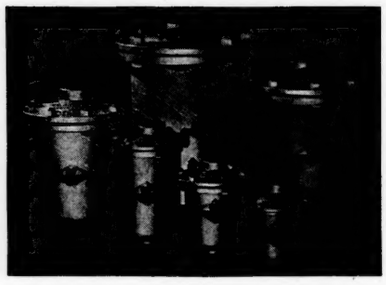
Gorton Air Eliminator

NAME AND MODEL NUMBER—Gorton high-pressure air eliminator and automatic bypass, No. 10.
PURPOSE—For quick and automatic venting of unit heaters, pipe coils, dryers and like equipment under varying steam pressures from 0 to 25 lb.
FEATURES—The operating member of the air eliminator is said to close at 212F and stay shut until the temperature drops below that point, when it automatically opens. The air eliminator also bypasses any extra condensation that may have accumulated. Where conditions require the bypassing of extra condensation, a pipe is connected at the ⅛ in. connection at the top of the air eliminator and the pipe run to a point beyond the steam trap and connected to the return main or direct to the open receiver. Valve is 2 in. in diameter, 3⅝ in. high overall and has a ¼-in. male as well as a ⅛-in. female bottom connection. The top of the air outlet is threaded for a ⅛-in. pipe connection for use as an automatic bypass when desired.
MADE BY—*Gorton Heating Corp., Cranford, N. J.* 1

April Showers Roof Coolers

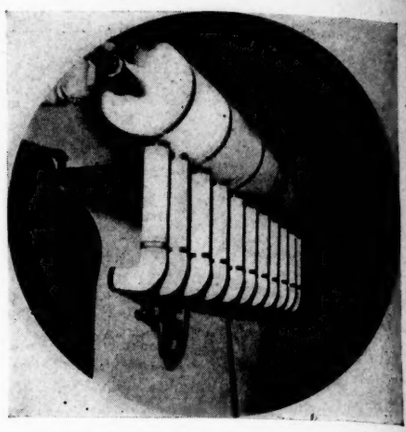
NAME—April Showers roof coolers.
PURPOSE—For reducing sun heat on roofs by the evaporation of water.
FEATURES—Roof cooling system consists of spray nozzles, thermal automatic control, and the necessary pipe and drain connections. The spray heads are made of bronze and are spaced on maximum centers of 16 ft. It is customary to space these heads in equilateral triangular formation to insure even coverage of spray. The thermal automatic control controls the operation of the spray heads. When the roof temperature reaches a predetermined point the automatic control allows water to flow into the spraying system. Water conductors are of type M copper, fitted with sweat-solder fittings. Where spray heads and drain valves are attached standard I.P.S. threaded fittings are used.
MADE BY—*April Showers Co., Washington, D. C.* 2





Anderson Air Release Valves

NAME—Anderson Silvertop air release valves.
PURPOSE—For automatically ridding pipe lines and other vessels of entrained air or any other gas.
FEATURES—The line includes three different styles of air release valves. First, the standard Silvertop which is made in six sizes (see illustration) from ½ to 2 in. inclusive for pressures up to 250 lb. per sq. in., second, the forged steel Silvertop for use on high pressures up to 1000 lb. per sq. in., and third, the Anderson No. "0" made for a maximum pressure of 150 lb. per sq. in. The release valves consist of a valve and fittings, a lever and ball float inside of a case. The inlet is at the bottom and the air vent is at the top. The liquid raises the float and holds the valve closed (a liquid is necessary to actuate the float; steam or other gases are not). An accumulation of air or gas lowers the liquid level, causing the float to drop. This opens the valve and vents the air or gas. Applications for the air release valve include hot water heating systems, brine lines, water mains, and for releasing air or gas from other liquid lines and tanks under pressure.
SIZES—Anderson No. "0", ¾ in. size.; standard Silvertop, six sizes from ½ to 2 in.; forged steel Silvertop, three sizes with pipe connections of ½, ¾, 1, 1¼, 1½ and 2 in.
MADE BY—*V. D. Anderson Company, Cleveland, Ohio.* 3

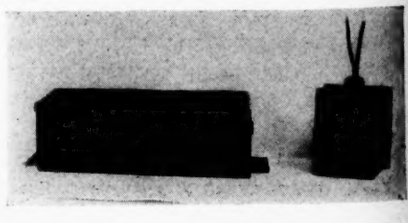


Taco Water Heater

NAME—Hi-Flow Tankless Taco.
PURPOSE—For use with large cast-iron steam boilers for supplying domestic hot water.
FEATURES—Indirect heater consists of a number of water tubes through which the water to be heated flows, and a shell which holds the boiler water. Boiler water is carried from the boiler to the heater by pipes tapped into each section of the boiler. Unusual feature of this heater is that it can be installed at a height of 30 in. or more above the boiler water line and a vacuum is utilized for holding the boiler water in the heater.
SIZES AND CAPACITIES—18 models with capacities ranging from 280 to 835 gal. per hr. 100F rise with boiler water at 180F.
MADE BY—*Taco Heaters, Inc., New York, N. Y.* 4

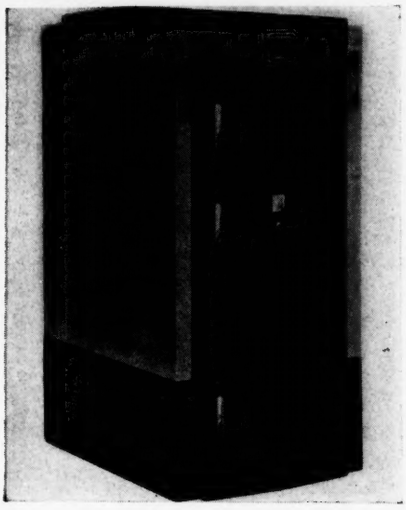
Automatic Electrical Devices Ozonizer

NAME—Homozone ozonizer.
PURPOSE—For generating ozone to remove odors from air.
FEATURES—The manufacturer states that this unit develops ozone in regulated quantities and that the ozone will oxidize through chemical action all odors. It is also stated that the addition of a very small quantity of ozone to any recirculating system permits an increase of from 33 1/3 to 50% of recirculated air. The unit is entirely electrical in operation.
MADE BY—*The Automatic Electrical Devices Co., Cincinnati, Ohio.* 5



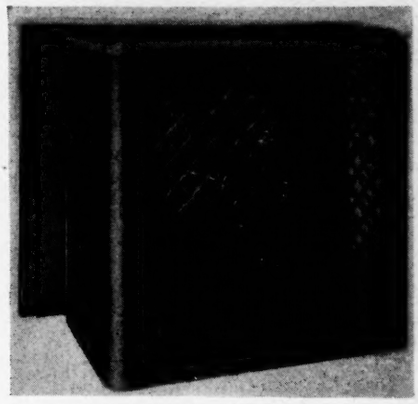
Smith Steam or Water Boiler

NAME—Mills Multi-sectional "15."
PURPOSE—For radiator heating.
FEATURES—Boiler is specially designed to meet the demands for the small home and is encased in a two color steel jacket. Manufacturer claims a high efficiency due to the long travel of the flue gases. Specially designed built-in horizontal type water heater is installed in the rear section. Boiler can be used for either hand or oil firing.
SIZES AND CAPACITIES — Three sizes rated for oil firing at 275 to 425 net installed square feet steam. When used with hand firing, ratings vary from 225 to 375 net installed square feet steam.
MADE BY — *H. B. Smith Co., Inc., Westfield, Mass.* 6



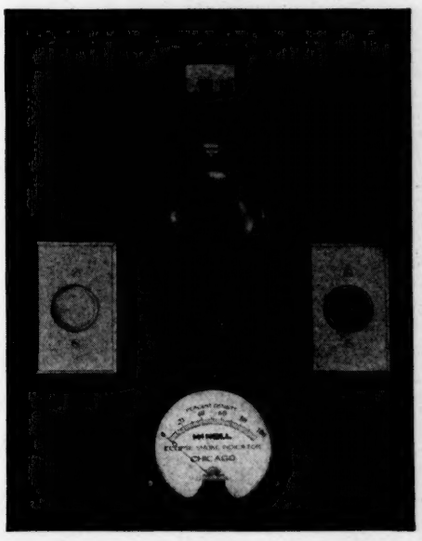
Wagner Air Cooling Equipment

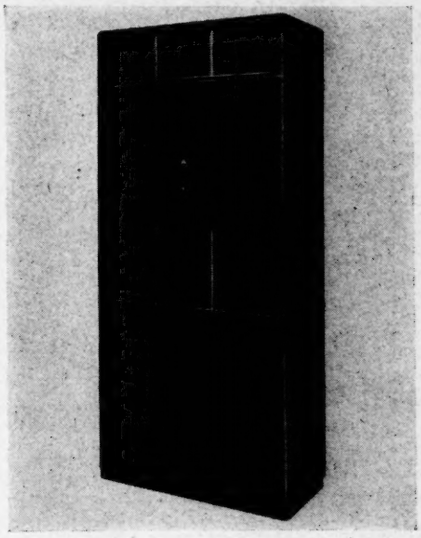
NAME—Home cooler and apartment cooler.
PURPOSE—For cooling houses and apartments using large quantities of air.
FEATURES—Home cooling unit consists of a fan mounted in a fan cabinet made of heavy gage steel with the walls acoustically treated. Fan and motor are mounted on rubber pads and the design of the steel fan blades is said to result in an extremely quiet operation. The apartment cooler is designed for installation in a window to blow air to the outdoors. Adjustable panels fit the cabinet into any window from 24- to 36-in. wide. Fan is equipped with a Wagner resilient mounted motor. In addition to these two items, the Wagner line includes ring-mounted coolers for installation in the wall and panel-mounted ventilators for windows and transoms.
SIZES AND CAPACITIES—Home cooler is made in four sizes with capacities from 7500 to 20,000 c.f.m. Apartment cooler has a capacity of 3200 c.f.m.
MADE BY—*Wagner Electric Corporation St. Louis, Mo.* 7



McNeill Smoke Indicators

NAME — McNeill Smoke Indicating Systems.
PURPOSE—For indicating and recording smoke conditions and to serve as a guide to economical boiler operation by enabling the fireman to guard against excess air.
FEATURES—A complete line of smoke indicating systems for indicating and recording flue gas conditions. Instruments employed may either be of the periscopic type or electrical type. The periscopic type of smoke indicating instrument consists of a light unit mounted on one side of the breeching, a sight window on the other side, and reflecting elbow pipe and a vision unit, which makes it possible for the fireman to observe flue gas conditions through the breeching window. The electrical type of smoke indicating instrument utilizes the light unit mounted on one side of the breeching and a light sensitive box on the other side. This light sensitive box may be used to operate a smoke density indicator which shows density in Ringelmann numbers, an audible alarm, red and green visual alarms, or any combination of these. The red and green lights may be operated so that the green light shows the probability of excess air and the red light objectionable smoke. The light sensitive box may also be used to make a permanent record of smoke conditions or of the time of duration of the period when the boiler is making smoke of objectionable density.
MADE BY—*T. W. McNeill Engineering Equipment Co., Chicago, Ill.* 8



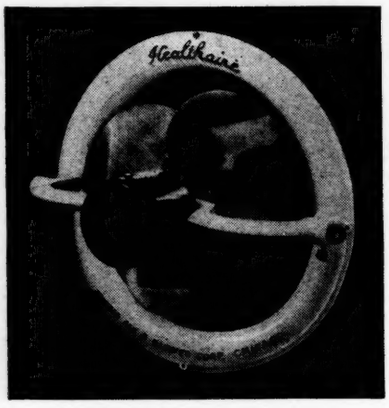


GR-Lipman Air Conditioner

NAME—GR-Lipman packaged air conditioning units.
PURPOSE—For summer cooling.
FEATURES — This line of packaged air conditioning units includes five models in two different types—one for home and office use and the other for commercial service. Room cooler model has lift-off type walnut cabinet which may be easily removed for servicing by detaching the two control knobs from the operating panel. An adjustable regulator regulates the length, angle and throw of the air stream. These two room cooler models are equipped with ¾ and 1 hp. compressors. Store conditioner is available in three sizes, 2, 3 and 5 hp. and is so designed that it may be recessed in store shelving, as all servicing may be taken care of from the front of the unit. The top section of these units comprises a combination plenum chamber and silencer and contains the air outlet grille. The lower section houses the condensing unit and controls. Illustration shows store cooler.
SIZES AVAILABLE — Room cooler models ¾ and 1 hp. Store conditioner models, 2, 3 and 5 hp.
MADE BY—*General Refrigeration Corporation, Beloit, Wisc.* 9

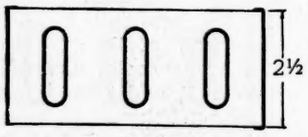
Johnson Propeller Fan

NAME—Special 12-in. propeller fan.
PURPOSE — For general ventilating applications.
FEATURES—Unit is said to deliver a high volume of air for its size and is quiet operating. It can be furnished with or without a 3 speed switch and is made for 110 volt alternating current only. Motor is totally enclosed and is of the non-radio interfering type. Blades are of aluminum, especially designed and all parts, except the motor, are furnished in a cream baked on enamel.
MADE BY — *Johnson Fan & Blower Corporation, Chicago, Ill.* *10*



Tuttle & Bailey Hot Water Copper Convectors

NAME—Copper convector.
PURPOSE—Copper convector for use with hot water heating systems.
FEATURES—Convector has a heating element which is made of large oval copper tubes with 2½-in. fins and with a new type of wrought copper header.
MADE BY—*Tuttle & Bailey, Inc., New Britain, Conn.* *11*

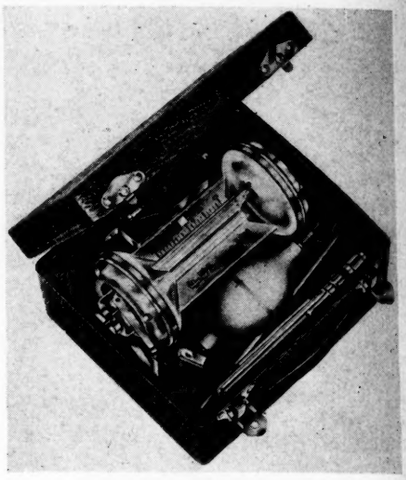


Friez Thermo-Anemometers

NAME—Friez Thermo-Anemometers.
PURPOSE—For measuring air velocities from 10 to 6000 ft. per min.
FEATURES — Instrument is suitable for use in open air, in front of grilles or registers and in ducts. It consists of a pair of accurate thermometers, 2 rheostats, a voltmeter, 4 small dry cells providing 6 volt current and the necessary connecting wire. A coil is wound around the bulb of one of the thermometers and is connected in series with the batteries and the rheostats which vary the voltage to the heater coil. The instrument operates on the principle that the air velocity being measured lowers the temperature of a heated thermometer, and the difference in temperature between the heated and unheated thermometers varies with the air velocity. The instrument is compensated for variations of temperature, humidity, radiant heat and self-generated convectional currents. Instrument is furnished with a small graph in the lid of the case, as well as a large graph on which is an equation for the individual instrument. Velocities may be obtained conveniently and rapidly from the small graph. If, however, greater accuracy is required, the use of the large graph is recommended, and if extreme accuracy is necessary, the equation is used.
TYPES AVAILABLE—Thermo-Anemometer A/50 temperatures 0 to 120F. A/51 for 50 to 200F. A/52 for 50 to 300F.
MADE BY — *Julien P. Friez & Sons, Baltimore, Md.* *12*

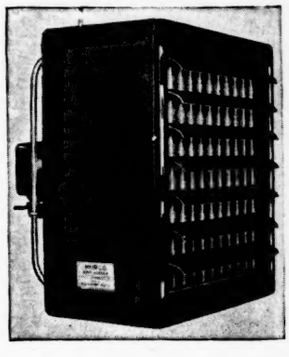
Hotstream Flue Gas Kit

NAME—Hotstream flue gas kit.
PURPOSE — For determining stack temperatures, carbon dioxide content of flue gases and draft.
FEATURES—Flue consists of a vest pocket draft gage, a small carbon dioxide analyzer and a stack thermometer. In using the analyzer, the carbon dioxide sample is pumped into the gas chamber through an aspirator bulb, the sampling hose is detached which seals the unit and the gas mixed with absorption fluid by merely turning the unit upside down. When it is returned to a normal position, the suction created by the absorbed CO_2 pulls the fluid into a graduated tube which indicates the percentage of volume absorbed. The price is $23.40.
SOLD BY—*The Hotstream Heater Co., Cleveland, Ohio.* *13*



Murray Unit Heater

NAME—Murco unit heater.
PURPOSE—For space heating.
FEATURES — Heating elements have heavy wall copper tubes and fins of the latest design. Condenser is full floating to overcome contraction and expansion. The unit is equipped with a unit heater duty totally enclosed motor. Case has a crackle finish, trimmed with chromium strips.
MADE BY — *D. J. Murray Mfg. Co., Wausau, Wisc.* *14*



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On the list below circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

(This service available only to engineers or executives)

Fill in your name and address, detach and mail to
HEATING & VENTILATING, 148 Lafayette St., New York, N. Y.

Name .....
Title .....
Firm .....
Business Address .....
City and State 8/39

WITH THE MANUFACTURERS

Propeller Fan Ratings Certified

DETROIT, MICH.—Three color certified rating stickers have been issued by the Propeller Fan Manufacturers Association for attachment to propeller fans made by member manufacturers. The sticker, which measures 1¾ by 2⅝ inches, is printed in red, blue and black and attests to the fact that air deliveries of the fan to which the

Certified ratings sticker of the Propeller Fan Manufacturers Association.

sticker is attached are in accordance with the standard test code for centrifugal and axial flow fans.

The association was formed several months ago and includes 15 members. M. W. Bauer of the Aerovent Fan Co., is president of the association and V. C. Shetler is secretary and treasurer. The secretary's office is located in the General Motors Building in Detroit.

Exposition Space Two Thirds Sold

NEW YORK—The Sixth International Heating and Ventilating Exposition, to be held in Cleveland, January 22-26, 1940, will be a marked success, advance information indicates. A total of 230 companies have engaged over two-thirds of the available exhibit space. The Exposition will be held in Lakeside Hall.

Advanced Stoker School Held by Anthracite Group

PRIMOS, PA.—The first of a series of advanced stoker schools being offered this summer by Anthracite Industries, Inc., opened here on June 26 with representatives of equipment dealers and service organizations in attendance from a widely scattered area. One of the largest warm-air heating equipment distributors in Northern New York State, for example, has four representatives registered at the school, with others listed from Virginia, Maryland, and Washington, D. C., as well as most New England states.

The course of study has been developed by the Industries' staff, in cooperation with leading stoker manufacturers, dealers and producing companies, and is presented by an experienced faculty.

Brown to be Secretary of Commerce

PHILADELPHIA—Richard P. Brown, former president and now chairman of the board of the Brown Instrument Company and vice-president of the Minneapolis - Honeywell Regulator Company, has been appointed by Governor Arthur H. James to be first secretary of the new department of commerce of the Commonwealth of Pennsylvania. Mr. Brown has been interested for some years in Pennsylvania's industrial development, increasing the number of jobs in private industry, and in reducing the relief load and taxation resulting from relief.

Richard P. Brown

Trane Awards Prizes in Contest for Steamfitter Apprentices

LA CROSSE, WIS.—A trade promotion was climaxed at the recent national convention of the Heating, Piping and Air Conditioning Contractors National Association when Chicago's superintendent of schools, William H. Johnson, presented prizes to the winners of an air conditioning contest conducted at the Washburne Trade School. The contest was sponsored by The Trane Company.

The prize awards were made at the Drake Hotel, scene of the three-day convention, in the presence of several leaders of the allied trades and of the Chicago school system. In addition to Superintendent Johnson, the following honored the occasion: John Coefield, president of the United Association of Steamfitters and vice-president of the American Federation of Labor; Philip L. McNamee, industrial co-ordinator of the Chicago Board of Education; W. E. Hill, principal of the Washburne Trade School; Wilson Frankland, vice-president of the steamfitters protective association and member of the Chicago School Board; Ray D. Berry, treasurer of the Chicago Master Steamfitters Association; William V. Hoier, chairman of the exhibitors' committee and William Goodman, author of the Trane Air Conditioning Manual.

The Washburne School, an outstanding unit in Chicago's public school system, offers instruction in air conditioning in its steamfitting department in order to assure contractors of trained help in maintaining air conditioning standards. To deepen the interest of Washburne students in the subject, G. F. Mannion, Chicago manager of Trane, announced the contest three months ago. Participants were asked to make all the calculations and plans preliminary to air conditioning the class room of the school's steamfitting department with a Trane Climate Changer.

Chicago educators and trade executives honor winners of Washburne Trade School—Trane contest. Left to right standing: R. D. Berry, Chicago Master Steamfitters Assoc.; William Goodman, Trane; John Coefield, president of the steamfitters union; Wilson Frankland, Chicago School Board; I. N. Walker, vice-president, Chicago School Board; Dr. W. H. Johnson, Chicago Supt. of Schools; W. V. Hoier, exhibitors committee; P. L. McNamee, Board of Education; W. E. Hill, principal, Washburne Trade School. Seated: George Jacobson, second prize winner; W. E. Cade, first prize winner; E. B. Carlson, co-winner of second place; R. Sommers, fourth place; George Morris, third place, and William Daly, fifth place.

Degree-Day Figures for June, 1939

HEATING & VENTILATING continues its eleventh year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for June, 1939	35	0	1	0	62	54	103
Degree-days, Sept. 1, '38 to June 30, '39	7000	2594	4044	2249	5984	6709	8048
Degree-days, Sept. 1, '37 to June 30, '38	6238	2835	4186	2442	5946	6705	7654
Degree-days, Sept. 1 to June 30, Normal	6580	2890	4533	2352	6045	6822	7514

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for June, 1939	141	32	6	19	9	28	15
Degree-days, Sept. 1, '38 to June 30, '39	7314	5840	4543	5491	4961	5637	5856
Degree-days, Sept. 1, '37 to June 30, '38	7080	6011	4820	5763	5172	5318	6104
Degree-days, Sept. 1 to June 30, Normal	7466	6290	4703	6155	5398	5874	6384

	Detroit, Mich	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for June, 1939	26	3	247	0	24	0	25
Degree-days, Sept. 1, '38 to June 30, '39	6246	4583	9487	2504	5884	3918	5736
Degree-days, Sept. 1, '37 to June 30, '38	6390	4692	9293	2140	6156	4048	6004
Degree-days, Sept. 1 to June 30, Normal	6490	5035	9443	2428	6273	4244	5924

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for June, 1939	0	30	61	5	19	14	33
Degree-days, Sept. 1, '38 to June 30, '39	2168	6136	7406	5130	5882	4862	6491
Degree-days, Sept. 1, '37 to June 30, '38	2141	6411	7609	5202	5870	5305	6492
Degree-days, Sept. 1 to June 30, Normal	2148	6535	7825	5375	6036	5298	6719

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for June, 1939	1	0	34	43	7	0	7
Degree-days, Sept. 1, '38 to June 30, '39	4475	3286	6909	6651	5303	2789	1270
Degree-days, Sept. 1, '37 to June 30, '38	4723	3357	7067	6838	5639	2790	1071
Degree-days, Sept. 1 to June 30, Normal	4852	3670	7322	7048	5999	2811	1504

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for June, 1939	1	30	0	42	39	0	19
Degree-days, Sept. 1, '38 to June 30, '39	4010	6844	2761	6495	7753	3225	5586
Degree-days, Sept. 1, '37 to June 30, '38	4233	7084	2826	6714	7729	3353	5585
Degree-days, Sept. 1 to June 30, Normal	4180	7429	2950	7245	7850	3507	5895

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for June, 1939	0	6	0	0	8	17	3
Degree-days, Sept. 1, '38 to June 30, '39	1008	4911	2878	3271	5605	5494	4531
Degree-days, Sept. 1, '37 to June 30, '38	1204	4976	3196	3447	5946	5681	4668
Degree-days, Sept. 1 to June 30, Normal	1024	5347	3350	3613	6131	6109	4855

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for June, 1939	3	141	132	40	9	112	0
Degree-days, Sept. 1, '38 to June 30, '39	4866	7070	3921	5738	4966	5216	3516
Degree-days, Sept. 1, '37 to June 30, '38	5083	6989	3892	5805	4963	5320	3724
Degree-days, Sept. 1 to June 30, Normal	5235	7012	4469	6015	5389	5892	3727

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for June, 1939	33	1	96	213	12	163	171
Degree-days, Sept. 1, '38 to June 30, '39	6466	4135	5421	2762	5913	4247	5874
Degree-days, Sept. 1, '37 to June 30, '38	6412	4374	4740	2674	5942	4030	5676
Degree-days, Sept. 1 to June 30, Normal	6732	4585	5555	2876	6129	4883	6355

	Springfield, Ill.	Syracuse, N. Y.	Toledo Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for June, 1939	8	25	23	4	36	1	0
Degree-days, Sept. 1, '38 to June 30, '39	4882	6434	5878	4986	7064	4099	4217
Degree-days, Sept. 1, '37 to June 30, '38	5081	6268	6023	5077	7002	4263	4392
Degree-days, Sept. 1 to June 30, Normal	5373	6893	6077	4933	6796	4626	4673

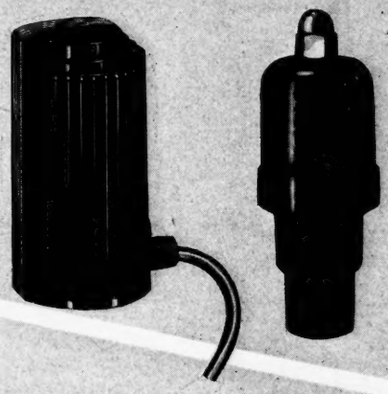
Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

Add to your own Profit and Reputation

BY PROVIDING MORE COMFORT FOR YOUR CUSTOMERS

PUT STEAM IN EVERY RADIATOR QUICKLY

The No. 300 Arco Detroit Multiport on each radiator and the No. 861 Arco Detroit Hurivent on the mains of a one-pipe steam system eliminate all the discomfort of the "hard-to-heat" room and all the delay in response to the thermostat's call for heat. These units, the No. 300 and the No. 861, together known as the Ideal Fast-Venting System, will do more than any other one thing to assure maximum performance of one-pipe steam systems.

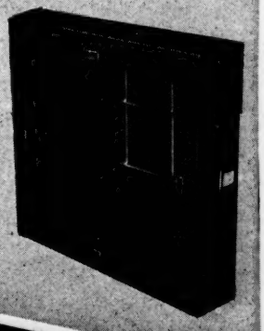


BALANCE HOT WATER JOBS

"Genuine Detroit" Balancing Elbows and Straight-Way Fittings make it easy to provide just the proper amount of flow to each radiator in the system—either gravity or forced circulation. Adjustment of individual radiators is quickly made after the system is in operation—no connections to break, no radiators to drain. ● "Genuine Detroit" Hot Water Valves are supplied for gravity or forced circulation in packed or packless construction with threaded or sweat connections.

ECONOMY AND SATISFACTION ON FORCED WARM AIR JOBS

The "Detroit" Air Filter (formerly the Arco Filter) assures maximum dust removal with a minimum of air resistance, and it retains its full capacity longer than other filter units because of its unique construction. It is odorless, allows no foreign matter to enter the air stream, acts as a sound insulator and is very economical.



GREATER COMFORT ON ANY HEATING SYSTEM

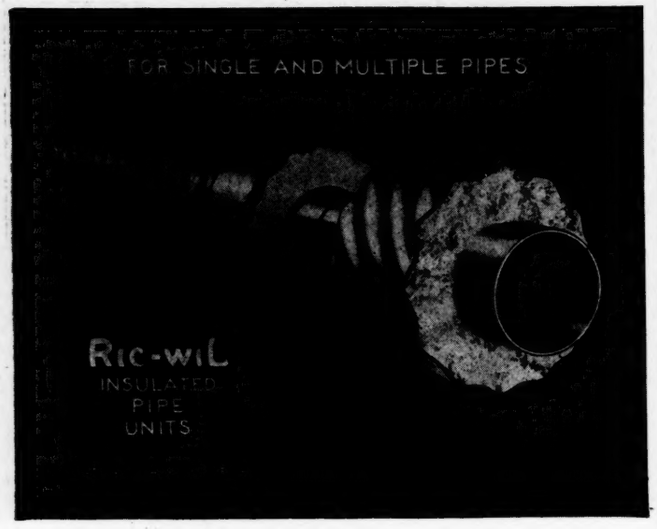
The "Genuine Detroit" Two-Eleven Thermostat with compensator prevents over-heating and "Cold 70". The amount of heat compensation required is dependent upon the type of building construction and kind of heating system. The Two-Eleven is the only thermostat available in which the amount of heat compensation required for each particular job is quickly and accurately secured with a screw driver adjustment—no assortment of pre-heater elements is necessary.

FOR SALE BY ALL LEADING WHOLESALERS

DETROIT LUBRICATOR COMPANY

General Offices DETROIT MICHIGAN

RAILWAY AND ENGINEERING SPECIALTIES



U. S. Patents 1,991,155 and 2,050,968. Canadian Patent 360,816. Other Patents Pending.

RIC-WIL Insulated PIPE UNITS

RIC-WIL PRE-SEALED UNITS for underground steam lines in 20-foot lengths come on the job completely assembled, ready for installation.

ARMCO HEL-COR CONDUIT is heavy gauge pure ingot iron, and on standard units is galvanized and coated outside with thick layer of asphalt.

WATERPROOF Hel-Cor lock seam, rolled in during manufacturing process, gives positively water-tight joint.

STRENGTH ample to meet every condition, impacts, etc., even in very shallow trenches—yet conduit is extremely light in weight.

DURABILITY—Armco experience indicates a life expectancy of 40 years in this type of conduit.

INSULATION for standard units is sectional 85% asbestos with heavy asphalt-felt jacket, with laps cemented (or any other insulation as specified).

PIPE SUPPORT GUIDES are semi-steel of sliding type, removable, and seal ends of units. Positive support and alignment. Pipes easily rotated for welding.

STEAM PIPE may be of any material, in 20-foot lengths or any lengths desired. Expansion of both pipe and units provided for in construction according to approved engineering practice.

CONNECTOR SLEEVES of heavy gauge Armco asbestos bonded ingot iron, easily slipped in place, and hermetically sealed with high melting point non-porous mastic cement furnished.

FITTINGS—elbows, T-branches, etc., also oversize conduit for expansion bends, furnished as needed.

Descriptive bulletin sent on request.

The RIC-WIL Co., Union Commerce Bldg., Cleveland, Ohio

New York **San Francisco** **Chicago**

AGENTS IN PRINCIPAL CITIES

REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

SUMMER DEGREE-HOURS (ABOVE 85F)* JUNE, 1939

City	June, 1939	June, 1938	Year 1939, to June 30	Year 1938, to June 30
Baltimore	393	220	593	226
Bismarck	22	112	104	112
Boston	12	62	26	81
Buffalo	1	0	1	2
Chicago	86	4	100	15
Cincinnati	127	64	151	68
Cleveland	20	8	22	8
Columbus	207	109	306	121
Des Moines	250	233	539	233
Detroit	23	51	56	51
Ft. Wayne	136	29	149	30
Grand Rapids	125	39	142	42
Indianapolis	202	26	297	26
Kansas City	393	264	620	276
Memphis	322	130	335	167
Milwaukee	69	1	98	1
Minneapolis	102	111	208	111
New Orleans	446	610	476	715
New York	26	8	64	8
Philadelphia	208	84	316	85
Pittsburgh	78	4	123	6
Portland, Ore.	1	45	98	79
Richmond, Va.	399	59	533	105
St. Louis	206	145	262	162
San Diego	0	0	15	0
San Francisco	0	0	0	0
Savannah	735	278	855	749
Toledo	61	51	84	58
Washington	264	209	499	223

*Based on data made available through the cooperation of the U. S. Weather Bureau.

NEW TRADE LITERATURE

Air Conditioning Units. A 4-page standard size bulletin S 398, illustrating and describing the Trane self-contained air conditioning units for small and medium commercial establishments. Gives information on unit conditioners which range in size from 3 to 10 hp. THE TRANE COMPANY, LA CROSSE, WIS. 15

Coal Pulverizers. A standard size 12-page two color catalog No. 639, describing the Mosley coal pulverizing mill. Booklet contains dimensional, capacity and installation data on this new mill in which dry materials pulverize themselves by attrition as a powerful current of air sweeps them around the grinding chamber. One section is devoted to the use of these mills for pulverizing and burning coal in medium size industrial boilers. STEPHENS-ADAMSON MFG. CO., AURORA, ILL. 16

Combustion Instruments. A standard size 4-page bulletin No. 21 on Dwyer Carbon Dioxide Indicators and Draft Gages. Gives information on the Dwyer Pocket CO_2 Indicator model 700, No. 750 and 775 testing sets and portable draft gages. The last page is devoted to a chart and explanation of the method of determining fuel losses in coal and oil fuel plants. F. W. DWYER MANUFACTURING CO., CHICAGO, ILL.....17

Fan Blades. A standard size 4-page bulletin No. 11639, illustrating and describing the Aristocrat line of attic fan blades. Models are available in sizes from 36- to 48-in. with 2, 3, or 4 blades. Bulletin illustrates and describes the blades, gives hub dimensions, fan number, shipping weights, air deliveries and horsepower. TORRINGTON MFG. CO., TORRINGTON, CONN...18

Filters. A standard size 8-page bulletin No. 250 describing the Electro-Matic filter. This filter is a new development combining electrical precipitation with automatic air filtration to obtain a high efficiency in air cleaning. Bulletin describes construction and operation and has diagram and cut-away sections to show how electric precipitation and automatic air filtration have been combined in a self-contained unit. AMERICAN AIR FILTER COMPANY, INC., LOUISVILLE, KY. 19

Oil Burner Motors. A standard size single page leaflet No. F 8487, illustrating and describing Westinghouse motors and the motor parts for industrial oil burners. Line includes a complete line of single phase and polyphase motor parts. WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, E. PITTSBURGH, PA. 20

Pipe Threading Machinery. A 32-page, standard size, profusely-illustrated catalog, in color, covering the Oster-Williams pipe threading and cutting tools and machines. Catalog 39-A. THE OSTER MANUFACTURING CO., CLEVELAND, OHIO. 21

Refrigerating Condensing Units. A 4-page standard size bulletin S 341 illustrating and describing Trane reciprocating condensing units. Gives detailed information on the construction and principal features of condensing units as well as a large cut-away view of a typical Trane compressor. Condensing unit capacities range from 3 to 50 ton. THE TRANE COMPANY, LA CROSSE, WIS. 22

Sheet Metal Machinery. A standard size 64-page catalog No. 39, describing machine tools and supplies for fabricating sheet metal equipment. Description is confined to products of well known manufacturers which are distributed by this company. Included are descriptions of brakes, dampers, various electrical tools, grinders, hammers, pressure brakes, punching machines and welders. WARD MACHINERY CO., CHICAGO, ILL. 23

Ventilators. A 6-page standard size bulletin SPV-6-A describing the Burt Monovent Continuous Ridge Ventilator. Gives information on design and construction as well as details of methods of mounting and damper control. BURT MANUFACTURING COMPANY, AKRON, OHIO. 24

Welding Fittings. A standard size 4-page bulletin No. 392, illustrating and describing the Centring Weld-ELL. This elbow has an internal ring which holds the elbow in the pipe without need for clamps or guides of any kind. It is said to be self-centering and it provides a guide for weld penetration. TAYLOR FORGE & PIPE WORKS, CHICAGO, ILL. 25

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HEATING & VENTILATING
148 Lafayette St., New York, N. Y.

15 16 17 18 19 20 21 22 23 24 25

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City and State **8/39**

We Pulled Its Legs To Pull More Sales for You

It always makes you and I madder than the Devil to get our leg pulled. But when we pulled the legs of a section ter make our new small house heating boiler, it didn't get mad at all. Just laughed loud like and started a-saying things at me.

Here's how I'm shipped already put together ready fur connecting up and no base ter monkey with.

First it said: Hank, when this pulled leg section that's me, gets hitched up ter two more like me, I'll be a complete all set up boiler, base and all, what's already fur connecting up the piping and slipping on my dandelion color jacket. No base to monkey with or nuthin. I'll be shipped all set up and ready.

I'll be the only cast iron boiler what's made all by itself just fur heating small homes what takes 250 sq. ft. of radiation fur steam or 400 fur water. I'll be a brand new boiler made out of whole cloth, and none of your papa's pants cut down to fit Willie.

Send for printin' matter and see me close up, both undressed and all dressed up in my dandelion colored jacket.

Hank Hindle

BURNHAM BOILER CORPORATION
Distributed Through Wholesalers
IRVINGTON, N. Y. ZANESVILLE, OHIO
Branch Offices in All Principal Cities
Export Dept.: 50 Church St., N. Y. City
Manufacturers of Heating Equipment Since 1873

Burnham Boiler

THERMOSTATIC CONTROLS *Must be Dependable*

Thermostatic controls depend on their thermal responsive element for accuracy of operation—once calibrated, these controls must always respond to temperature changes in the same manner—year after year for the life of the product it is intended to control; there must be no let up.

Even the slightest shift or variation from its original calibration may seriously impair the service of the product which the control operates and thereby very decidedly handicap the manufacturer's future sales efforts. A few cents saved in the first cost by using a control element of questionable uniformity is to be "penny-wise and pound-foolish," it may mean the difference between success and failure for the manufacturer of the control and the product which the thermostat controls.

Chace High Temperature Thermostatic Bimetals are dependable, they will not "creep," they cannot leak, they offer service-free uniformity of operation even at excessive temperatures—year in and year out—Chace High Temperature Thermostatic Bimetals outlast the product which they control.

Specify Chace High Temperature Thermostatic Bimetals as the control element for your product.

W. M. CHACE CO.
1606 Beard Ave., DETROIT, MICHIGAN

WITH THE MANUFACTURERS

Airtemp Division, Chrysler Corp., Dayton, Ohio, has appointed *V. P. Black* as advertising manager to succeed *A. K. Snyder*, resigned. Mr. Black has been connected with Airtemp for the past four and a half years. Prior to that he was with Frigidaire. Airtemp has appointed four new distributors as follows: Air-Rite Corp., Dallas, Texas; Anchor Lite Appliance Co., Pittsburgh; Automatic Heat Sales Co., Aurora, Ill.; and Lockie & Glenn, Cincinnati.

The Burkay Company, Toledo, Ohio, has appointed *Walter G. Groth* as vice president in charge of sales.

Frick Company, Inc., Waynesboro, Pa., announces that *Alvin H. Baer* has rejoined the company as executive assistant, with headquarters at the New York branch office of the firm at 370 Lexington Avenue. Mr. Baer was for thirty years with Frick Company and has numerous patents covering refrigerating and ice making. He is a former president of the Refrigerating Machinery Association and the ASRE.

Jones and Laughlin Steel Corp., Pittsburgh, Pa., announces that *H. Leigh Whitelaw*, former vice president of the American Gas Products Corporation has become associated with that company.

The Kehm Corp., Chicago, has been formed to conduct a general heating and air conditioning business through the following divisions: *Force-Flo* division, formerly the Stevens-Root Co.; *Contracting* division, formerly Kehm Bros. Company; and *Corozone* air conditioning sales division. The contracting division will be located at 51 East Grand Avenue and the Corozone activities at 441 No. LaSalle Street. Executive personnel: president, *H. S. Kehm;* vice presidents, *C. G. Newton* and *H. R. Coleman;* secretary-treasurer, *W. A. Mertz;* sales managers, *R. Follansbee* and *J. W. Manny*.

Research Products Corporation, Madison, Wis., has added *R. C. Poucher* to its sales staff. He will be in charge of sales engineering problems for the air filter division in Ohio, Michigan, Pennsylvania and New York.

Spence Engineering Co., Inc., 75 West St., New York, has purchased the plant and business of the *Rider-Ericsson Engine Corp.*, Walden, N. Y. This plant was founded in 1842 by *Captain John Ericsson*, builder of the *Monitor*. Spence will furnish repair parts for Rider-Ericsson hot air engines and Reeco pumps as required but the plant will primarily be devoted to the manufacture of Spence regulators.

The American Rolling Mill Co., Middletown, Ohio, closed down its Open Hearth, blooming and bar, and hot strip mill departments July 3 for a mammoth $4½ million modernization job which will require about 1200 men working for a month. Plans provide for the replacement of the present steam driven blooming mill with a modern slabbing mill driven by two 5000 hp. motors. The hot strip mill will also be re-vamped and widened.

The Spraying Systems Co., 4021 West Lake St., Chicago, Ill., has announced that they have recently moved their offices and plant to new and larger quarters at the address given above.

COMING EVENTS

SEPTEMBER 20-22, 1939. Annual Conference, National Industrial Advertisers Association, Hotel New Yorker, New York. Headquarters NIAA, 100 East Ohio St., Chicago.

OCTOBER 4-6, 1939. Exposition of Building, Industry and Services, Hotel Statler, Detroit, Mich. Sponsored by the Mortgage Bankers Association of America. George H. Patterson, Secretary-Treasurer, 111 West Washington St., Chicago, Ill.

OCTOBER 17-20, 1939. 68th Annual Meeting, American Public Health Association, William Penn Hotel, Pittsburgh, Pa. APHA headquarters, 50 West 50th St., New York.

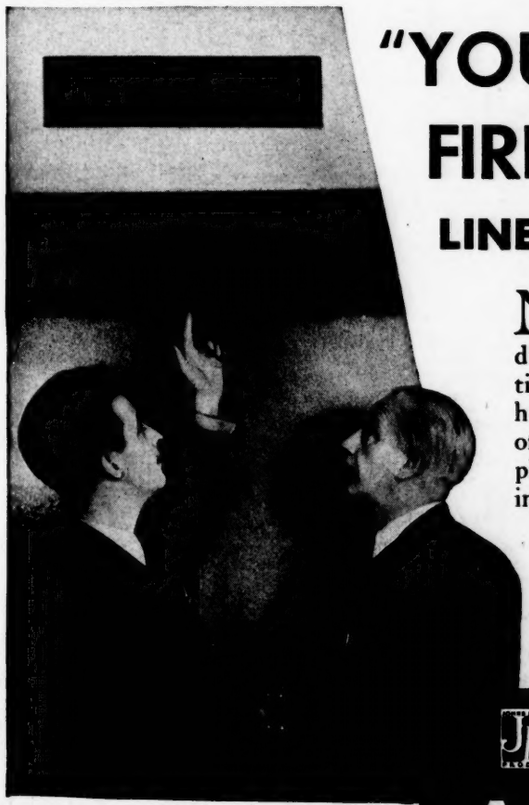
JANUARY 15-18, 1940. Sixth annual convention of the Refrigeration Service Engineers Society in conjunction with the Second All-Industry Refrigeration and Air Conditioning Exhibition sponsored by the Refrigeration Equipment Manufacturers Association, to be held in Chicago. National Secretary of the Society, H. T. McDermott, 433 N. Waller Ave., Chicago.

JANUARY 16-18, 1940. 35th Annual Meeting, American Society of Refrigerating Engineers, Hotel Blackstone, Chicago, Ill. ASRE headquarters, 37 West 39th St., New York.

JANUARY 22-24, 1940. Annual convention, National Warm Air Heating and Air Conditioning Association, Hotel Hollenden, Cleveland, Ohio. To be held in conjunction with the Sixth International Heating and Ventilating Exposition. NWAH & AC Assoc., Managing Director, 5 E. Long St., Columbus.

JANUARY 22-26, 1940. 46th annual meeting of the American Society of Heating and Ventilating Engineers, Hotel Statler, Cleveland, Ohio. To be held in conjunction with the Sixth International Heating and Ventilating Exposition. ASHVE, 51 Madison Ave., New York.

JANUARY 22-26, 1940. Sixth International Heating and Ventilating Exposition to be held at Lakeside Hall, Cleveland. Exposition under the direction of Charles F. Roth, International Exposition Co., Grand Central Palace, New York.



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NOISY air-conditioning ducts can be annoying . . . and ducts that are lined with combustible materials present a definite hazard. Yet you can avoid both of these dangers . . . assure complete customer satisfaction . . . by installing ducts lined with J-M Airacoustic Sheets.

This modern duct lining absorbs more than 70% of all sounds in the duct. Basically mineral in composition, Airacoustic Sheets will not contribute to the spread of fire. And, being highly moisture resistant, they provide maximum protection against damage caused by excessive humidity.

In addition, Airacoustic Sheets are strong and durable, yet light in weight. Easy to apply and handle, they make good-sized reductions in installation costs. For full details, write Johns-Manville, 22 East 40th St., New York, N. Y.

NO FIRE HAZARD or complaints about noisy ducts when you use J-M Airacoustic Sheets for linings. This basically mineral lining will not contribute to the spread of fire . . . absorbs more than 70% of all sound in the ducts.

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